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A regional dredging disposal plan is to be developed for the tidal portions of the Delaware River, its tidal tributaries and Delaware Bay, extending from Trenton New Jersey to the sea and for Indian River Inlet and Bay. This reconnaissance report is written to present technical background as foundation for the study. Various appendices of this plan focus on environmental impacts of dredge disposal and inventory various fish and wildlife in the area. Historic and archeological sites are also listed. Various plates provide maps of different actual and proposed disposal areas.

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NOTICE

DELAWARE RIVER DREDGING DISPOSAL STUDY

STAGE 1 RECONNAISSANCE REPORT

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Description

DELAWARE RIVER DREDGING DISPOSAL STUDY

CHAPTER I

INTRODUCTION

This Reconnaissance Report is written to present the background, goals and objectives, and general conduct of the study. It will serve as a management tool to define the scope and character of the study and to determine whether additional study is warranted.

BACKGROUND AND AUTHORITY

Recognizing the spoil disposal problem, the Delaware River Basin Commission adopted Resolution No. 74-8, on 26 June 1974. This resolution requested that the Corps of Engineers expedite its continuing authorized navigation studies and that its initial efforts be directed toward:

a. The development of a dredging spoil disposal plan for the tidal Delaware River, its tidal tributaries and Delaware Bay; and,

b. Designation of specific sites which may be used on a short-term basis, with minimum degradation of the natural environment, by both the public and private sectors for the disposal of dredging spoil and the identification of potential sites which may be used for this purpose thereafter. This was to include an appraisal of the environmental impacts of utilizing dry, marsh and submerged sites for spoil disposal. During the course of preparing this plan, the Corps of Engineers was requested to draw upon the services of and consult with

other Federal and state agencies having responsibilities for environmental protection of the Delaware Estuary and Bay. Copies of this resolution were made available to the Chief of Engineers, the Secretary of the Army and the Congressional delegates of the Delaware River Basin.

Following the passage of this resolution, Senators William V. Roth, Jr. and Joseph R. Biden, Jr. of Delaware requested that the Senate Committee on Public Works consider the problem. Accordingly, on 20 September 1974, a resolution concerning a study to develop a regional dredging spoil disposal plan for the tidal Delaware River, its tidal tributaries and Delaware Bay was adopted by the Senate Committee on Public Works. In addition, on 24 July 1978 the Senate Committee on the Environment and Public Works increased the scope of the study to include Indian River Inlet and Bay. Copies of these resolutions are included in Appendix A.

SCOPE OF STUDY

The purpose of this planning study is to develop a regional dredging spoil disposal plan for the tidal portions of the Delaware River, its tidal tributaries and Delaware Bay, extending from Trenton, New Jersey to the sea, and for Indian River Inlet and Bay. The scope of the plan is to include both the public and private sectors. Such a study would include investigations to assess current and future dredging requirements of Federal, state and private interests; locate potential future spoil disposal sites; formulate alternative dredged spoil disposal and utilization techniques to include determination of impact assessment and evaluation; establish competitive land uses in the estuaries; and screen

all potential alternatives. The study would also assess the current and projected future problems associated with present dredging disposal methods, necessitate in-depth institutional analyses, and include an active public involvement and participation program.

COORDINATION

In February 1978 formal announcement of the initiation of the study was made to all known interested Federal, state, county and local elected officials and agencies, clearinghouses, special interest groups and interested individuals. A copy of this announcement and the list of interested parties is included in Appendix B and questions or problems identified from responses to it are shown on Tables 16 and 17 in Chapter V, Views of Concerned Interests.

Informal coordination has been effected with the Delaware River Basin Commission (DRBC), the Delaware Valley Regional Planning Commission (DVRPC), the U.S. Fish and Wildlife Service, the National Marine Fisheries Service and the U.S. Geological Survey. Informal coordination has also been effected with the U.S. Environmental Protection Agency (EPA), the state environmental departments of New Jersey and Pennsylvania, which includes their Offices of Coastal Zone Management (OCZM), and Delaware's Department of Natural Resources and Environmental Control (DNREC) and OCZM. In addition, the Corps Waterways Experiment Station (WES) through the Dredged Material Research Program (DMRP) has played an active advisory role.

Both the State College, Pa. and Annapolis, Md., offices of the U.S. Fish and Wildlife Service are providing their services for the study, under contract to the Corps. Their work involves the providing fish and wildlife inventory data and assessing the general impact that dredging disposal would have on fish and wildlife resources. The reports pertaining to this work are included in Appendix C, Natural Resources. Included in Appendix B are planning aid letters that they have written in reference to the disposal study's initiation announcement and for the Indian River Inl and Bay navigation study. Representatives from both offices and the Sandy Hook N.J. office of the National Marine Fisheries Service participated in the Preliminary Plan Formulation Meetings.

The U.S. Geological Survey is also under contract to the Corps. They are performing a chemical analysis of bottom sediments in the navigation channel of the Delaware River from Trenton to Reedy Point.

Representatives from this District met with WES's Dredging Operations Technical Support Team (DOTS) in Vicksburg, Mississippi. The results of the Dredged Material Research Program (DMRP) and how to apply these results to the disposal problems in the Philadelphia District were discussed. In addition, members of the DOTS team attended the Preliminary Plan Formulation Meetings.

The DRBC, DVRPC, EPA, environmental departments of the three states (including the OCZM for New Jersey and Pennsylvania) and Delaware's

OCZM have all expressed their interest in participating in the study. Much information has already been provided by them for this Stage 1 study.

OTHER STUDIES

Long Range Spoil Disposal Study (LRSDS). Realizing the diminishing availability of riparian land for use as disposal sites resulting from land use pressures motivated by normal regional growth, the Philadelphia District in the late 1950's through the late 1960's embarked on an extensive program to locate and establish additional disposal sites for the Delaware River navigation projects. This program culminated in the Long Range Spoil Disposal Study, an internal Operations and Maintenance program investigation completed in 1969.

The goal of the study was to locate and obtain disposal areas which were within efficient pumping distance of the dredging requirement for the Philadelphia to Sea project. However, the goal had its limiting factors. Vast land areas along the Delaware River had already been consumed with dredged fill. Many marsh and low lands had been filled and many of those remaining had been designated fish and wildlife or water resource areas. Landowners were reluctant to enter into long term spoil disposal easements where the filling of their land would not result in land enhancement. Proposed fee acquisition of potential disposal areas met with intense landowner opposition and opposition from local, county and state officials. In addition, Delaware River maintenance spoil is not always desirable land fill material because of its high silt content. Three potential new disposal areas were identified: Goose Island, Chester-

Monds Island, and Tinicum Island. However, realistic planning for these sites required the following assumptions:

a. Only 66% of the Chester-Monds Island potential can be filled before the area is lost due to other essential land use requirements.

b. Development of the Goose Island area would not take place because of severe criteria imposed by the landowner.

c. Potential of the Tinicum Disposal area would not be realized due to opposition by local interests.

The study concluded that maintenance of the Delaware River channel from Philadelphia to the sea would be possible by present day approaches until 1990. The report also pointed out that, should new disposal sites not be developed, any new work would shorten the life span of existing disposal sites.

Environmental Impact Statements. An EIS for Project Maintenance of the Delaware River, Trenton to the Sea, (including Schuylkill River and Wilmington Harbor) was prepared by the District in 1975.

The following are significant comments made by agencies reviewing the Delaware River EIS, in regards to the potential disposal areas identified in the LRSDS:

U.S. Environmental Protection Agency

- Desired separate EIS for Chester-Monds, Tinicum or Goose Island.

U.S. Department of the Interior

- Goose Island area has significant fish and wildlife resource value and should be preserved.

- Alternative methods which will exclude disposal at Goose Island should be studied because the island contains extensive mud flats. (The U.S. Fish and Wildlife Service reiterates its recommendations in their planning aid letter of 22 June 1978.)

Delaware River Basin Commission

- Concern for use of Goose Island site due to loss of segment of the estuarine ecosystem.

- Goose Island should not be considered unless a marsh can be developed.

N.J. Department of Environmental Protection

- Avoid disposal on riparian land; Goose Island should be eliminated.

Pa. Department of Environmental Resources

- Concerned over the use of Tinicum Island site.

Another EIS was prepared by the District in 1975 in conjunction with the proposed modification of the Delaware River, Philadelphia to Trenton (Senate Document No. 95-88), specifically in the area of the Tioga Marine Terminal. Comments from a few agencies expressed concern as to how the contractor's proposed disposal areas would be evaluated in determining environmental impacts. Other comments made concerning disposal areas were:

Delaware River Basin Commission

- prefers upland disposal of any contaminated sediments.

Pa. Department of Environmental Resources

- Doesn't approve use of existing spoil disposal areas in Pa. for this modification of the original project.

N.J. Department of Environmental Protection

- A long-term disposal program is needed for future dredging projects.

An EIS was prepared for the District in 1975 for the Project Maintenance of Indian River Inlet. Comments received, concerning spoil disposal, are cited as follows:

U.S. *Department of the Interior*

- Suggest consideration of alternative spoil disposal methods; especially endorse concept of the creation of new tidal marsh.

U.S. Environmental Protection Agency

- The Corps should considerably expand its discussion of creating marshland; should also discuss the feasibility of disposing material in unnatural deep holes in the proximity (created by previous dredging) and for use in protecting the highway north of Indian River Inlet.

University of Delaware Marine Laboratories

- Agree on marsh development to stabilize intertidal areas of spoil site.

Delaware Department of Natural Resources and Environmental Control

- Urge creation of artificial wetland from dredged spoil disposal; if not, use upland sites.

Office of the Assistant Secretary of Commerce

- Spoil disposal should be timed to avoid periods of fish and wildlife spawning and migration, as well as intensive recreational use.

- Should prepare comprehensive spoil disposal plan; plan should provide for cessation of overboard disposal.

- Use of spoil as marsh development and erosion control.

Environmental assessments were prepared recently (1978) by the Philadelphia District on Indian River and Bay maintenance dredging. One was for open water disposal of dredge spoil and the other for land disposal. It was recommended that only land disposal sites be used and that no environmental impact statement is required. Reference was made to the Indian River Inlet and Bay EIS.

Negative declarations or determinations reports were prepared by the District for other Federal navigation projects in the study area. These reports and their year of publication are listed as follows:

Delaware

Murderkill River	1975
Mispillion River	1975
Broadkill River	1975
Inland Waterway, Rehoboth Bay to Delaware Bay	1974
Harbor of Refuge	1975
Waterway from Indian River Inlet to Rehoboth Bay	1974

New Jersey

Cooper River, Big Timber Creek, Mantua Creek, Raccoon Creek	1975
Salem River, Cohansey River	1975

Pennsylvania

Neshaminy State Park Harbor	1975

These reports give a brief description of the local environments and the potential impacts on them from dredging and dredging disposal. Projected dredging frequency is given and the availability, if any, of using past disposal areas is mentioned. No new sites were reviewed.

Other EIS's worth citing were those submitted by the states along with their Coastal Zone Management Programs. New Jersey completed its final report in August 1978 while Delaware submitted a draft report in March 1979. Pennsylvania has not yet completed their report.

Dredged Material Research Program (DMRP). This program has been conducted by the Environmental Effects Laboratory of the U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

As originally authorized and implemented, the DMRP has sought answers to questions of why and under what circumatances does the disposal of dredged material produce adverse environmental impacts. It has produced generic knowledge of the processes and mechanisms involved in environmental impacts, and most important, methods for predicting effects before a project is carried out or a permit issued. It has resulted in methods of evaluating the relative impacts of alternatives for use by planners and design engineers. More significantly, it has produced tested, viable, cost-effective methods and guidelines for reducing the impacts of conventional disposal alternatives, while pointing out the tradeoffs involved and removed much of the uncertainty and discredit surrounding new disposal alternatives or possibilities.

Attention has constantly been focused on keeping the DMRP as broadly applicable as possible on a national basis. No major type of dredging activity or region or environmental setting has been excluded. While it may not be apparent, such output as management guidelines for confined disposal facilities and habitat development on disposal sites are as applicable in the Great Lakes area of the Mississippi Valley as they are on the West or East Coasts.

As a result of this program, nearly 200 technical reports have been published and widely distributed within and outside the Corps. These have been or are in the process of being supplemented with 21 synthesis reports, an index and retrieval system, a summary report, and special documents for Congress and the public. In addition, a technical advisory team has been established for the specific purpose of assisting Corps Districts and Divisions and the agencies and groups they interrelate with in understanding the significance of DMRP results and how they can be applied to individual projects or studies. This team, managed under the name Dredging Operations Technical Support (DOTS), has already begun to assist the Philadelphia District as mentioned in the section on coordination.

Delaware River Shallows Study. This study was completed in March of 1979 and it was concerned with evaluating the shallow water resources of the upper Delaware Estuary, from Reedy Point, Delaware to Trenton, New Jersey. Shallow water areas are defined as those areas from the mean low water line to the -10 foot mean low water contour. The purpose of the study

is to define these areas, and to develop a system by which their ecological value to the estuary can be evaluated. Such evaluations will assist personnel of the Philadelphia District, U.S. Army Corps of Engineers, in processing permit applications involving encroachments within the study area.

Delaware Estuary Salinity Intrusion Study. The Philadelphia District is conducting this study which was authorized in a resolution adopted by the House Committee on Public Works and Transportation on 23 September 1976. The resolution directs the study to determine the probability for advance or retreat of salinity in the Delaware Estuary and the quantity of fresh water inflow needed to protect the various water users along the estuary. The Stage 1 Reconnaissance Report for this study was completed November 1978. An active interchange with this study will be necessary due to the relation between salinity and sediment deposition.

Comprehensive (Level B) Study. The Delaware River Basin Commission is conducting this study of the Delaware River Basin under the authority of Section 209 of the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500). The major purpose of the Level B study is to provide a basis for a reformulation and updating of the present Comprehensive Plan of the DRBC. Under the Level B study, alternative plans are being developed that will address various areas including water quality; water supply; flood loss reduction; fish and wildlife; recreation, conservation, and preservation; energy; and navigation.

CHAPTER II

DESCRIPTION OF THE STUDY AREA AND ITS RESOURCES

STUDY AREA

The regional dredging spoil disposal plan is to be developed for the tidal portions of the Delaware River, its tidal tributaries and Delaware Bay, extending from Trenton, New Jersey to the sea, and for Indian River Inlet and Bay. There are 13 counties encompassing the study area as shown on Figure 1. They are listed as follows:

New Jersey
- Burlington County
- Camden County
- Cape May County
- Cumberland County
- Gloucester County
- Mercer County
- Salem County

Pennsylvania
- Bucks County
- Delaware County
- Philadelphia County

Delaware
- Kent County
- New Castle County
- Sussex County

NATURAL RESOURCES

Environmental Overview. Appendix C, Natural Resources, includes a report entitled "Overview Inventory and Potential Impact Discussion." This report is designed as an environmental overview of the Delaware

Estuary and thirteen adjacent counties in Pennsylvania, New Jersey and Delaware. Features covered are climate, physiography, soils, surface water, groundwater, wetlands, vegetation (other than wetlands), and water and shore-based recreation. A general inventory of these features is developed, and the potential impacts of dredging and dredge disposal activities are discussed. Projections of recreational needs and surface water quality are made in those counties for which information was available. For all other features, only existing conditions are discussed. Fish and wildlife inventory data is treated separately.

Both positive and negative potential impacts of dredging and disposal activities on the resources of each county and the potential of natural features to impact dredging and disposal activities are summarized and ranked in Table 1. The table indicates that wetlands and groundwater are two natural resources which may be severely impacted by dredging and/or disposal of dredged material. Groundwater quality in some counties is more likely to be affected by disposal than in others, though the consequences are equally as important in all counties. Wetlands may be severely disturbed by dredging and disposal. Some shoreline soils in all counties pose constraints on disposal of dredged material, but testing would be necessary to determine the severity of the limitations. Surface water can be affected by turbidity and heavy metals from dredging operations, though the magnitude of the impact decreases as the distance from the dredging site increases. The potential impacts of dredging and dredged material disposal on recreation are both positive and negative. Turbidity from dredging operations may temporarily affect

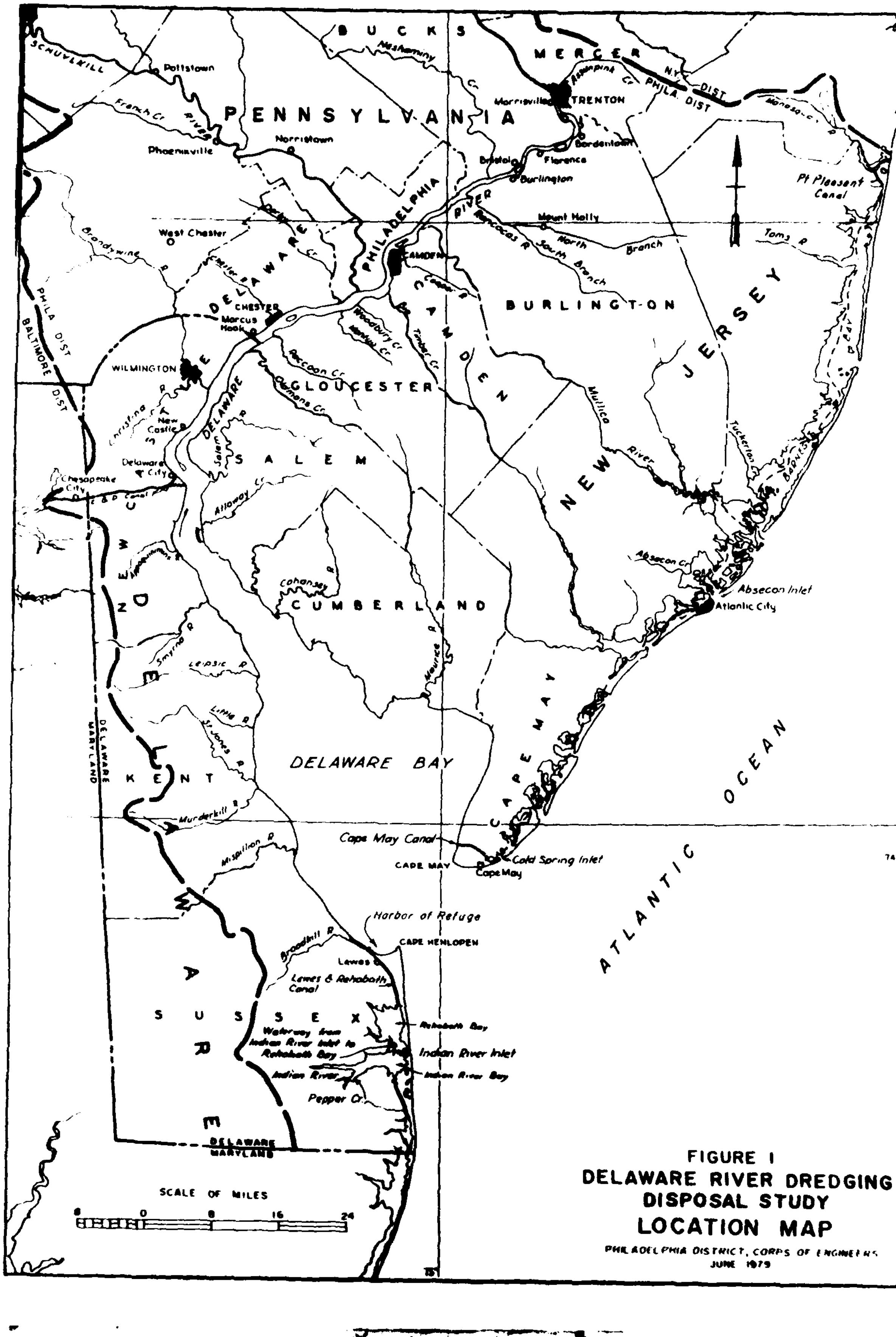


FIGURE I
DELAWARE RIVER DREDGING DISPOSAL STUDY
LOCATION MAP
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
JUNE 1979

TABLE 1

POTENTIAL IMPACTS OF DREDGING AND DISPOSAL ACTIVITIES ON NATURAL FEATURES(1)

County	Feature(2)							
	Climate	Physiography	Soils	Surface Water	Groundwater	Wetlands	Vegetation	Recreation
Bucks	3	4	2	2	1	1	3	2
Philadelphia	3	4	2	2	1	1	3	2
Delaware	3	4	2	2	2	1	3	2
Mercer	3	4	2	2	2	1	3	2
Burlington	3	4	2	2	2	1	3	2
Camden	3	4	2	2	1	1	3	2
Gloucester	3	4	2	2	2	1	3	2
Salem	3	4	2	2	1	1	4	4
Cumberland	3	4	2	3	1	1	4	4
Cape May	3	4	2	3	1	1	4	4
New Castle	3	4	2	2	1	1	4	4
Kent	3	4	2	3	1	1	4	4
Sussex	3	4	2	2	1	1	4	4

(1) Impacts are rated by significance as follows:

1 = Likely to be very severe, and negative
2 = Positive and negative impacts moderately significant, probability of occurrence low
3 = Positive and negative impacts minimally significant, probability of occurrence low
4 = No significant impact foreseen

(2) Nature of Impact

Climate: Occasional storms may temporarily impact dredging activities
Physiography: Steep slopes may limit availability of disposal sites; site studies needed
Soils: Soils must be tested to identify constraints; many limitations can be corrected
Surface Water: Turbidity and heavy metals may impact streams very close to dredging and disposal sites
Groundwater: Kirkwood-Cohansey and Pleistocene deposits very vulnerable to spoil deposition; overpumped areas of Magothy-Raritan vulnerable
Wetlands: All wetlands negatively impacted by dredged material disposal, dredging of wetlands and dredging of sites immediately adjacent
Vegetation: Disposal activities not likely to impact non-wetlands vegetation; few remaining natural areas in urban counties should be protected
Recreation: Use of dredged material disposal sites for recreation can help satisfy demands in these counties; turbidity temporarily impacts existing recreation

existing recreation sites in some counties. However, waterfront recreation land is so sparse in the same counties that dredged material disposal may prove to be beneficial if the sites are made available for recreational use.

Fish and Wildlife. The Natural Resources Appendix includes reports on fish and wildlife inventories for Delaware's Atlantic coastal bays and the Delaware River and Bay region from Trenton to the sea. More than a general inventory of fish and wildlife species in the study area, these reports also briefly outline areas sensitive to disposal impacts. The reports discuss finfish, benthic invertebrates, commercial and recreational fisheries, wetland wildlife and threatened/endangered species. The reports also discuss river, bay, tidal segments of tributaries and all adjoining wetlands.

The following are some general highlights of the reports:

a. Numerous fishery samplings from Trenton to the Chesapeake and Delaware Canal, circa 1972 to 1976, in the mainstem and tributaries identified a range from 12 species in the Christina River to 31 species in the Delaware River tidal tributaries between Trenton and Wilmington.

b. Similar samplings in the Delaware Bay region have identified 218 species.

c. Anadramous fish spawn in upper reaches of the Delaware River.

d. The estuary is an important breeding ground and nursery area.

e. Planktonic forms of 23 species have been identified in the Maurice River, a tidal tributary in the study area.

f. Benthos studies are relatively new and data scarce. One hundred and twenty-five species were identified in Delaware Bay in 1973.

g. Delaware River commercial fish catch average value from 1973-1977 was $3.1 million; from the New Jersey side only, an average value of over $1.7 million was reported between 1948-1975 for oyster, crab and menhaden. Over 34 thousand pounds of hard clams, the most important commercial shellfish in the Indian River and Bay area, were harvested in 1975.

h. The Delaware River and Bay produce at least 1.2 million man-days annually of fisherman use valued at $19.0 million. Indian River Bay is probably equal to half of that figure.

i. Indian River Bay has been a site of heavy spawning concentrations of winter flounder.

j. Wetlands and adjoining upland provide essential habitat for a variety of vertebrates. In the Delaware River area alone over 144 bird species, 22 amphibian species, 22 reptile species and 17 mammal species use that habitat. Over 300,000 ducks and geese winter over in this area. More than 320,000 man-days are expended by bird hunters, over 77,000 man-days for trapping and almost 15 million man-days for wildlife photography/observation.

k. About 17 threatened or endangered species range in the study area; however, none have been positively cited as inhabitants. Four species of plants may be proposed for inclusion on the endangered list. There are 15 threatened or endangered species in the Indian River Inlet and Bay area.

l. Impacts on wetlands, shallows and water quality are the most sensitive areas of concern and activities affecting those parameters should be carefully considered. Estuarine biota depend upon or are subject to a myriad of natural or artificial regulations, including temperature, flow, salinity, water quality, substrate, food, season and cover. These factors and certainly many more individually or synergistically determine species' presence, abundance, activity and human use. Despite such variables, certain generalizations are valid, as follows:

(1) Wetland plants, including emergent, submergent and floating leaf hydrophytes, nearly always provide valuable habitat for fish and wildlife. The study area still has a significant wetland acreage of which over 90 percent of the wetlands occur south of Wilmington. Therefore, remaining wetlands north of this city take on added importance. The U.S. Fish and Wildlife Service would like to see new wetlands created between Trenton and Philadelphia.

(2) Non-vegetated shallow water areas also provide food, cover, and nursery and spawning habitat. Although it is not well-documented, the current biological opinion is that non-vegetated shallows can be made

more productive by establishing wetland plants. This generalization is not necessarily true for all shallows, or for that matter, all species. The U.S. Fish and Wildlife Service is generally protective of shallow water areas, particularly where water quality is good or is likely to improve, and occasionally approves conversion of deepwater areas into shallow water habitats. Once created, it is preferred that they also be planted with wetland vegetation. These proposals must be reviewed on a case by case basis.

(3) Other sensitive areas include oyster seed beds and leased areas, blue crab dredging areas, hard clam beds, spawning and nursery grounds for important commercial/recreational finfish, and islands. Islands serve as natural refuges for migrating waterfowl and other bird life and are sometimes heavily used for nesting.

(4) Water/land interfaces (shorelines) should be protected from extreme alteration because of their value as sites for terrestrial/aquatic transfers of nutrients, energy and organisms.

In general, the body of biological information available suggests that developed areas are least valuable for fish and wildlife. A good example of this is the Philadelphia-Wilmington corridor which has a limited fish population for about half the year. The problem is due mainly to poor water quality. However, even if water quality significantly improved, it is likely that fish productivity there would still be lower than in other less developed areas where habitat is more diverse.

HUMAN RESOURCES

Population. Provisional estimates for 1975 indicate a population of just over five million for the entire study area. County totals range from a concentration of 1,824,900 in Philadelphia County, Pennsylvania to 62,600 in Salem County, New Jersey according to the 1975 U.S. Bureau of Census estimates. A more appropriate comparison is the difference in population density. In 1975, Philadelphia County had a density of 14,147 people per square mile while Sussex County, Delaware had a density of 94 people per square mile. This difference is indicative of the variations of usage from urban areas to spacious rural areas.

According to Table 2, the population is increasing in most counties. However, Delaware and Philadelphia Counties in Pennsylvania showed a 2.8 percent and 6.4 percent decrease respectively from 1970 to 1975. These trends are expected to continue through 1995.

Housing. The housing in the study area includes many varieties of dwellings from houses built in the 1700's to modern multi-unit complexes. In 1970, the median value of single family dwellings ranged from $10,703 in Philadelphia County, Pennsylvania to $18,671 in Bucks County, Pennsylvania. This difference demonstrates the assortment of dwellings present. As shown in Table 3, the number of housing units increased between 1960-1970. This is indicative of the growth which is characteristic of many counties of the study area.

TABLE 2
POPULATION AND POPULATION DENSITY

County	Area (Sq. Miles)	Population 1970	Population Density 1970	Population 1975 (Provisional)	Population Density 1975	Percent Change 1970-75	Population Projection 1995
New Jersey							
Burlington	818	323,132	395	341,100	417	5.6	522,000
Camden	222	456,291	2,055	477,000	2,149	4.5	546,500
Cape May	263	59,554	226	72,100	274	21.1	148,800
Cumberland	502	121,374	242	132,900	265	9.5	166,700
Gloucester	328	172,681	526	187,800	573	8.8	263,900
Mercer	226	304,116	1,346	320,500	1,418	5.4	373,500
Salem	347	60,346	174	62,600	180	3.7	69,400
Pennsylvania							
Bucks	614	416,728	679	457,700	745	9.8	526,900
Delaware	184	603,456	3,280	586,700	3,189	-2.8	573,600
Philadelphia	129	1,949,996	15,116	1,824,900	14,147	-6.4	1,692,600
Delaware							
Kent	595	81,892	138	91,600	154	11.9	152,927
New Castle	437	385,856	883	399,000	913	3.4	474,215
Sussex	946	80,356	85	88,600	94	10.2	133,413
TOTAL - Study Area	5,611	5,015,778	894	5,042,500	899	0.5	5,644,455

Sources:
An Economic Profile of Camden County, 1978
New Jersey Interim Population Projections 1980-2000; 1978
Pa. Projection Series Summary Report - #78 PPS-1, 1978
U.S. Bureau of Census Estimates of the Population of Counties and Metropolitan Areas:
July 1, 1974 and 1975; 1977
New Castle County Profile - August 15, 1978
N.C.C. Department of Planning

TABLE 3

HOUSING, 1970

County	Units	Percent Increase in Units (1960-1970)	Median Value of Single Family Dwellings
New Jersey			
Burlington	87,753	50.4	$18,537
Camden	143,150	20.8	15,309
Cape May	28,335	60.0	14,213
Cumberland	38,932	15.7	13,743
Gloucester	51,075	25.6	15,683
Mercer	96,401	21.6	17,350
Salem	19,408	5.6	13,534
Pennsylvania			
Bucks	121,433	38.5	18,617
Delaware	184,370	14.0	17,868
Philadelphia	673,356	3.9	10,703
Delaware			
Kent	25,037	30.0	16,261
New Castle	120,646	27.8	17,895
Sussex	29,307	22.0	14,117

Source: County and City Data Book - 1972, Bureau of the Census

Employment and Income. The classes of industry which employ the majority of persons in the study area are manufacturing and wholesale and retail trade. In Salem County, New Jersey, as high as 66 percent of the labor force is employed in manufacturing. Another important field of employment is service, which exhibits a range of 10 percent to 23.9 percent in Salem County and Mercer County, New Jersey, respectively.

As shown in Table 4 the 1970 unemployment rates ranged from 2.8 percent in Delaware County, Pennsylvania, and Sussex County, Delaware, to 6.5 percent in Cape May County, New Jersey. These figures have continued to increase in the past decade.

The 1970 per capita income throughout the study area varied approximately $1,000 and had an average of $3,135. The 1970 median family income for each county is listed in Table 5. Delaware County, Pennsylvania held the highest median family income in 1970 with $11,819. The percentage of families below the poverty level ranged from 12.6 percent in Sussex County, Delaware, to 4.1 percent in Bucks County, Pennsylvania.

Education. The 1970 median number of years of school attendance for the 2,766,000 persons 25 years or older in the study area was 11.6. The highest median, which is 12.3, was found in Burlington County, New Jersey, and Delaware County, Pennsylvania. Approximately 48.6 percent of the persons 25 years or older have finished high school. According to Table 6, New Castle County with 15.1 percent has the highest percentage of adults with 4 or more years of college.

TABLE 4

EMPLOYMENT AND UNEMPLOYMENT, 1970 1/
(Percent) 2/

County	EMPLOYMENT							
	Construction	Manufacturing	Transportation, Communication, and Utilities	Wholesale and Retail Trade	Finance, Insurance and Real Estate	Services	Other	UNEMPLOYMENT
New Jersey								
Burlington	8.3	30.0	6.4	31.9	4.2	17.7	1.5	3.9
Camden	6.1	27.4	6.7	30.8	5.4	22.5	1.1	4.0
Cape May	16.5	9.2	5.1	37.4	8.2	19.4	4.2	6.5
Cumberland	3.9	48.1	6.4	19.4	5.9	13.8	2.5	5.7
Gloucester	6.9	37.4	5.8	31.3	3.9	13.6	1.1	4.0
Mercer	3.0	35.9	4.7	21.1	5.3	28.9	1.1	3.5
Salem	2.2	65.8	3.2	16.4	2.0	10.0	0.4	3.7
Pennsylvania								
Bucks	4.8	43.9	2.5	28.1	3.2	15.8	1.4	3.0
Delaware	6.4	33.9	3.0	27.5	5.6	22.6	1.0	2.8
Philadelphia	5.7	27.8	7.9	21.1	11.3	25.7	0.5	4.6
Delaware								
Kent	6.2	35.9	7.2	29.4	4.6	15.2	1.5	4.2
New Castle	7.9	33.5	5.7	26.6	6.0	19.4	0.9	3.9
Sussex	8.4	45.1	3. 9	22.6	3.6	14.3	2.1	2.8

1/ Excludes government employees, railroad employees, and self-employed persons.
2/ Employment figures are percentages of total employment; unemployment figures are percentages of the labor force.

Sources:
County Business Patters, 1974 - U.S. Department of Commerce, Bureau of the Census
County and City Data Book - 1972, Bureau of the Census

TABLE 5

INCOME - 1970

County	Medium Family Income	Per Capita Income	% Families Below Poverty Level
New Jersey			
Burlington	$11,352	$3,294	5.3
Camden	10,959	3,343	6.8
Cape May	8,295	3,067	8.9
Cumberland	9,522	2,882	9.3
Gloucester	10,620	3,032	5.8
Mercer	11,165	3,626	6.5
Salem	10,214	3,088	8.6
Pennsylvania			
Bucks	11,649	3,403	4.1
Delaware	11,819	3,713	4.6
Philadelphia	9,361	3,017	11.2
Delaware			
Kent	8,257	2,649	12.6
New Castle	10,983	3,539	6.6
Sussex	8,500	2,579	11.6

Source: County and City Data Book - 1972, Bureau of the Census

TABLE 6

EDUCATIONAL CHARACTERISTICS - 1970

County	Persons 25 Years or Older	Median School Years	Less than 5 Years School	4 (or more) of High School	4 (or more) of College
New Jersey					
Burlington	196,661	12.3	2.7%	59.6%	12.6%
Camden	251,522	11.9	4.4	49.1	9.8
Cape May	37,471	11.3	5.6	45.2	7.3
Cumberland	66,317	10.7	7.2	40.0	5.7
Gloucester	91,005	11.8	3.9	48.7	8.0
Mercer	171,[illegible]	12.1	5.1	52.8	14.1
Salem	33,336	11.3	6.0	44.8	5.7
Pennsylvania					
Bucks	213,459	12.2	2.0	59.1	12.1
Delaware	335,008	12.3	2.8	60.4	13.9
Philadelphia	1,121,029	10.9	6.7	39.9	6.8
Delaware					
Kent	39,521	12.1	3.4	52.3	9.6
New Castle	203,135	12.[illegible]	3.3	57.6	15.1
Sussex	44,739	11.1	5.9	43.0	6.8
Study Area	2,766,000	11.6	-	-	-

Source: County and City Data Book - 1972, Bureau of the Census

DEVELOPMENT

Land Use. The study area includes every classifiable type of land use, ranging from the highly urbanized metropolitan areas to the pine barrens of southern New Jersey. In between are large suburban areas and extensive farmlands. Urban land uses, including residential, commercial, and industrial uses, are concentrated in the major cities and their suburbs and along the major ground transportation routes. Urbanization is continuing within the fringes of the urban areas and along the transportation routes.

Table 7 summarizes the available existing land use data for the counties. The most recent comprehensive land use plans and maps of the counties have been obtained for sources of land use information.

Transportation. An extensive network of limited access highways supported by a system of secondary roads provides excellent highway transportation throughout the study area. Interstates 95 and 295 are important links in the Washington-New York transportation corridor. The New Jersey, Delaware and Pennsylvania Turnpikes provide access to most major urban centers in their respective states. The Atlantic City Expressway and Garden State Parkway enable recreationists to reach New Jersey's ocean resorts. U.S. Routes 13 and 113 extend the length of the Delmarva Peninsula connecting Wilmington, Delaware, with Norfolk, Virginia, while U.S. Route 301 connects Wilmington to Baltimore. The supporting inter-connecting State, County and local road systems enable all counties to benefit from the highway transit network.

TABLE [illegible]

EXISTING LAND USE 1/
(Acres)

County	Land Area	Residential	Transportation, Communication, and Utilities	Commercial	Manufacturing and Industry	Public Use (Including Recreation)	Agricultural, Mining, and Extraction	Woodlands, Marshes, Undeveloped, Water	Other
New Jersey									
Burlington	534,527	[illegible],231	14,15[illegible]	3,5[illegible]3	1,5[illegible]0	32,516	126,555	327,[illegible]97	-
Camden	147,247	[illegible],736	[illegible],705	4,321	1,993	7,943	23,955	69,344	-
Cape May a/	170,880	7%	-	-	-	-	-	73%	20%
Cumberland b/	321,920	(		10% urban	)	10%	25%	55%	-
Gloucester	219,336	19,526	7,437	4,851	2,246	4,211	73,656	107,459	-
Mercer	150,295	22,098	10,389	3,894	1,305	8,232	57,736	46,641	-
Salem c/	222,641	8,604	9,270	956	1,957	6,354	101,558	93,943	-
Pennsylvania									
Bucks	400,000	52,701	15,032	6,260	5,525	12,783	122,726	184,974	-
Delaware	126,901	35,055	12,013	4,771	2,065	11,277	18,763	42,952	-
Philadelphia	120,966	27,173	23,859	8,413	5,181	16,217	1,460	38,663	-
Delaware									
Kent d/	380,800	6,304	7,458	1,075	336	29,936	328,837	2,935	2,919
New Castle 2/e/	271,327	21,199	14,365	1,329	3,817	9,484	(221,132)		-
Sussex f/	605,440	(	6% urban		)	-	-	(43% woodlands)	51%

1/ **Existing land use is based on the most recent available data.**
2/ Excludes City of Wilmington (7,008 acres), category breakdown not available.

Sources:
Delaware Valley **Regional Planning** Commission (1970), except **where** noted
a/ Cape May County Planning Board (1975)
b/ Cumberland County Planning Board (1966)
c/ Salem County Planning Board (1976)
d/ Kent County Planning Board (1970)
e/ New Castle County Planning Board (1964)
f/ Sussex County Planning Board (1968)

The region's vast network of commuter rail lines, rapid transit, light rail and surface transit provides a high level of accessibility in the urban areas and along radial corridors throughout the region. Major rail service is provided to the study area and the entire northeastern United States along the New York-Philadelphia-Washington corridor. Commuter rail service radiates between Philadelphia and adjacent Pennsylvania counties, northern Delaware and Camden and Mercer Counties in New Jersey. Commuter rail service is also available to resort communities in Atlantic and Cape May Counties in New Jersey. Rail service is available at more than 200 stations in the study area. Bus lines utilize the extensive highway system to provide transportation between most counties in the study area and the major urban centers. Bus lines supplement rail service in the area by providing service from outlying areas to rail stations. Commuter bus service is also available within Philadelphia, Wilmington and other major urban centers.

The study area's largest airport is Philadelphia International Airport which provides service to over 70 domestic cities and many foreign cities. The Greater Wilmington Airport, North Philadelphia Airport, Mercer County Airport and Millville Municipal Airport provide most of the remaining commercial air service in the study area. Most counties and some larger municipalities maintain their respective small air fields providing air taxi and private plane services.

Commerce. There are 15 port areas and two open-bay areas which are significant handlers of waterborne commerce along Delaware River and

Bay from Trenton to Cape May, New Jersey. Philadelphia Harbor handles the most traffic. Other large ports in the study area are Paulsboro, New Jersey, Marcus Hook, Pennsylvania, and New Castle, Delaware. Tonnage moving through each of the major ports along the Delaware River in 1977 is shown in Table 8.

TABLE 8

SUMMARY OF TRAFFIC
DELAWARE RIVER AND TRIBUTARIES,
TRENTON, N.J. TO THE SEA, 1977
(short tons)

Locality	Total
Trenton Harbor, N.J.	1,248,100
Burlington-Florence-Roebling, N.J.	970,200
Riverton-Delanco-Beverly, N.J.	703,500
Penn Manor, Pa., and Vicinity	5,311,200
Bristol, Pa., and Vicinity	85,700
Philadelphia Harbor, Pa.	49,710,600
Camden-Gloucester, N.J.	7,170,900
Chester, Pa.	781,600
Marcus Hook, Pa., and Vicinity	29,780,400
Paulsboro, N.J., and Vicinity	27,014,700
Thompson Point, N.J., and Vicinity	624,900
Wilmington Harbor, Del.	2,917,800
Penns Grove-Carney Point, N.J.	454,500
New Castle, Del., and Vicinity	10,994,400
Artificial Island, N.J., and Vicinity	2,100
Lower Delaware Bay, N.J.	86,500
Lower Delaware Bay, Del.	18,299,900
Gross Total	156,156,900
Net Total	132,408,500

Note: The net total eliminates activities between localities.

The ports along the Delaware River account for 42 percent of the North Atlantic bulk traffic. The total volume of cargo which moved through the various port facilities in this region totaled more than 132

million short tons in 1977. The absolute increase in import tonnage between 1969 and 1976 was about 9 million tons. Foreign exports have increased during these years while domestic shipments have declined. Major imports include petroleum products, metallic ores, primary metal products, sugar and molasses, and non-metallic minerals. Major exports include farm products (grains), coal, scrap metals, chemicals and allied products. The major domestic commodity is non-metallic minerals. Other domestic commodities include scrap metals, coal, chemicals and allied products. The ports along the Delaware River lead the U.S. in total international commerce, are second nationally in total waterborne commerce and are third internationally in total waterborne commerce.

Though not a major center of commerce, the Indian River Inlet and Bay area serves as both an active recreational boating area and a thoroughfare for the passage of recreational vessels to other recreational users. Commerce is generally limited to commercial fishing vessles. These conditions also hold for Rehoboth Bay and the other inland waterways of Delaware's Atlantic coast as the State of Delaware desires to maintain them as natural areas. Industrial development is prohibited in the vicinity of the bays.

Other tidal tributaries in the study area which serve as active recreational boating areas and/or commercial fishing foci are the Mispillion and Murderkill Rivers in Delaware and the Maurice River in New Jersey. Tables 9 and 10 give a breakdown of the movements on these and other active Federal navigation projects.

TABLE ·

COMMODITY MOVEMENTS DURING 1977 IN ACTIVE FEDERAL PROJECTS
(Quantities in Thousands of Short Tons)

Project	Fish & Farm Products	Coal, Petroleum & Allied Products	Metallic Ores	Non-metallic Minerals (Ex. Fuels)	Wood Products	Chemicals & Allied Products	Metal Products	Food Products	Waste & Scrap Materials	All Others	Total
Delaware River Phila - Trenton	61.3	6,754.3	3,981.6	961.5	29.4	410.8	738.7	109.7	437.1	79.9	13,564.3
Phila - the Sea	542.0	99,635.8	3,491.1	606.0	596.0	1,960.5	2,485.3	1,547.3	330.6	179.4	111,433.7
at Camden 1/	12.0	627.4	153.7	470.4	330.3	7.9	460.3	115.1	342.1	15.0	2,534.2
Schuylkill River	1,270.5	10,417.3	-	154.5	6.0	422.3	135.0	29.3	226.7	8.3	12,672.9
Wilmington Harbor	110.6	1,330.5	123.3	272.9	166.9	77.4	293.9	21.0	-	20.8	2,917.8
Big Timber Creek	-	98.0	-	-	-	129.2	-	-	-	-	227.2
Cohansey River	-	32.1	-	-	-	-	-	-	-	-	32.1
Cooper River	-	40.6	-	-	-	-	-	-	-	-	40.6
Harbor of Refuge	-	-	-	-	-	6.8	-	-	-	-	6.8
Indian River Inlet	0.5	-	-	-	-	-	-	-	-	-	0.5
Inland Waterway, Rehob. Bay - Del. Bay	-	-	-	-	0.7	-	0.5	-	-	-	1.2
Mantua Creek	-	24.7	42.2	-	66.2	33.2	1.5	-	-	-	167.8
Maurice River	6.5	-	-	-	-	-	-	-	-	-	6.5
Pepper Creek	0.5	-	-	-	-	-	-	-	-	-	0.5
Smyrna River	0.1	-	-	-	-	-	-	-	-	-	0.1
									TOTAL		141,064.7 2/

1/ This project is also included in Phila. to the Sea figures.
2/ Note: This figure differs from that in Table 8 because it includes the gross totals of other localities, not shown there.

Source: 1977 Waterborne Commerce of the U.S., Part I, Waterways and Harbors, Atlantic Coast

TABLE 10

SUMMARY OF COMMERCIAL MOVEMENTS IN ACTIVE FEDERAL PROJECTS
(Quantities in Thousands of Short Tons)

Project	1960 Freight	1960 Passengers	1965 Freight	1965 Passengers	1970 Freight	1970 Passengers	1975 Freight	1975 Passengers	1977 Freight	1977 Passengers
Delaware River										
Phila. to Trenton	14,918.7	17.5	20,442.5	-	21,610.8	15.3	18,220.8	-	13,564.3	-
Phila. to the Sea	77,345.3	2,804.6	82,176.4	2,618.1	98,995.0	4,513.3	106,899.7	1,578.5	111,433.7	1,175.9
at Camden 1/	1,746.2	2.4	2,647.4	2.9	2,545.8	-	2,590.5	0.2	2,534.2	0.3
Schuylkill River	13,259.5	-	12,549.5	-	14,147.3	-	13,160.0	-	12,672.9	-
Wilmington Harbor	2,230.8	-	2,391.7	-	2,760.6	-	3,226.6	-	2,917.8	-
Big Timber Creek	150.8	-	269.3	0.3	399.4	0.1	191.8	-	227.2	-
Cohansey River	NA		72.1	0.4	51.4	-	47.8	-	32.1	-
Cooper River	NA		19.9	-	72.1	-	62.7	-	40.6	-
Harbor of Refuge	NA		26.2	569.7	9.5	569.8	11.2	516.7	6.8	774.1
Indian River Inlet & Bay	NA		-	33.1	0.2	40.1	0.2	13.9	.5	11.3
Inland Waterway between Rehoboth Bay and Delaware Bay	NA		0.8	13.0	14.3	11.2	1.7	16.3	1.2	37.9
Little River	NA		-	-	0.2	-	-	-	-	-
Mantua Creek	207.7		256.3	-	228.8	-	198.3	-	167.8	-
Maurice River	NA		6.5	2.0	7.5	7.3	16.4	8.7	6.5	5.4
Mispillion River	NA		23.7	10.0	9.1	-	-	12.7	-	19.3
Murderkill River	NA		0.1	7.3	0.2	8.0	-	13.5	-	22.7
Pepper Creek	NA		-	-	-	-	0.1	-	0.5	0.2
Smyrna River	NA		0.1	-	-	-	0.1	-	0.1	-
Waterway from Indian River Inlet to Rehoboth Bay	NA		-	6.8	-	-	-	-	-	2.5
Salem River	NA		7.6	-	-	-	-	-	-	-

1/ This project is also included in Phila. to the Sea figures.

Source: 1977 Waterborne Commerce of the U.S., Part I, Waterways and Harbors, Atlantic Coast

CULTURAL RESOURCES

Appendix D includes reports entitled "Cultural Resources Overview and Sensitivity Analysis for the Delaware River and Bay" and "Cultural Resources Overview, Indian River and Bay." These reports were specifically oriented toward establishing zones of probable cultural resource sensitivity based on analysis of known resources. The approach was necessary because of the vast areas to be covered in the study and because site specific solutions to dredge disposal are not necessary in Stage 1. The basic research of the reports involved examination of State files, literature search, consultation with professional and amateur archeologists and field verifications. The results of the studies are annotated on maps which rank probability of historic and archeological activity in the project areas. These maps will be compared with disposal area alternatives, as they develop, to determine where additional cultural resource studies are to be made, or, where sites are known to be evident. A general synopsis of the reports and an analysis of the sensitivity maps indicate the following:

a. Prehistoric archeological sites occur on certain landforms, including stream terraces and elevations within and bordering marshes.

b. Sites are situated along streams, especially near confluences. Freshwater and brackish streams served both as resource procurement loci and transportation routes.

c. Sites are located in and near the extensive marshes typical of the Bay, primarily for reasons of resource availability.

d. Prehistoric sites tend to concentrate near modern population centers. Land clearing for construction and agriculture has exposed sites, increasing the likelihood of their discovery by amateur and professional archeologists. Modern settlements also tend to be situated in proximity to streams and critical resources which also were attractants for prehistoric peoples.

e. A review of the Inventory of Protected Sites indicates that as of December 1978 the study area contains 166 historic sites and districts which have been officially determined to possess cultural significance. A total of 161 of these sites and districts have been listed in, or judged eligible for listing in, the National Register of Historic Places. Section 106 of the National Historic Preservation Act of 1966 requires federal review of any federally funded undertaking which might have an adverse effect upon any property listed in the National Register. Similar State laws require review of publicly funded projects which might encroach upon or destroy any listed property.

EXISTING INSTITUTIONS

The status report on public institution represented in the study area which affect or will be affected by the implementation of a regional dredging spoil disposal plan, is included in Appendix E. They include Federal, regional, state and local agencies, their legal authority, spatial coverage, functional role, and program responsibilities. The agencies described are characterized by their respective roles in implementing a number of Federal, as well as state, policies in order

to protect the environment from any adverse impact from the dredge spoil-disposal-related activities.

The institutions identified in Appendix E are listed as follows:

FEDERAL AGENCIES

U.S. Environmental Protection Agency

U.S. Army Corps of Engineers (Corps)

U.S. Department of the Interior
- U.S. Fish and Wildlife Service
- National Park Service
- Bureau of Land Management (BLM)
- Heritage Conservation and Recreation Service
- Bureau of Mines
- U.S. Geological Survey

U.S. Department of Commerce
- Maritime Administration
- National Oceanic and Atmospheric Administration (NOAA)

U.S. Department of Health, Education, and Welfare (HEW)
- Public Health Service
- Center for Disease Control

U.S. Department of Housing and Urban Development (HUD)
- Federal Insurance Administration (FIA)

U.S. Department of Transportation (DOT)
- U.S. Coast Guard
- Federal Railroad Administration (FRA)
- Materials Transportation Bureau

U.S. Department of Agriculture
- Soil Conservation Service (SCS)

REGIONAL AGENCIES

Delaware River Basin Commission (DRBC)
Delaware Valley Regional Planning Commission (DVRPC)
Wilmington Metropolitan Area Planning and Coordinating Council (WILMAPCO)
Delaware River and Bay Authority (DRBA)
Delaware River Port Authority (DRPA)

STATE AGENCIES

New Jersey
- New Jersey Department of Environmental Protection (DEP)
- New Jersey Department of Agriculture
- New Jersey Department of Community Affairs (DCA)
- New Jersey Department of Transportation (DOT)
- New Jersey State Budget Office

Delaware
- Delaware Department of Natural Resources and Environmental Control (DNREC)
- Delaware Department of Health and Social Services, Division of Public Health
- Delaware Department of Transportation, Division of Highways
- Delaware Department of Community Affairs and Economic Development
- Delaware Solid Waste Authority
- Delaware Office of Management, Budget, and Planning (OMB&P)

Pennsylvania
- Pennsylvania Department of Environmental Resources (DER)
- Pennsylvania Fish Commission
- Pennsylvania Department of Transportation (PennDOT)
- Pennsylvania Department of Commerce, Navigation Commission
- Pennsylvania Department of Community Affairs (DCA)
- Pennsylvania Office of the Budget

LOCAL AGENCIES

Various county agencies are also briefly discussed for the following counties:

New Jersey
- Burlington County
- Camden County
- Cape May County
- Cumberland County
- Gloucester County
- Mercer County
- Salem County

Delaware
- Kent County
- New Castle County
- Sussex County

Pennsylvania
- Bucks County
- Delaware County
- City of Philadelphia

However, since the number of municipalities within the counties is in the hundreds and their agencies are similar, the municipalities are merely listed in the appendix.

CHAPTER III

PROBLEM IDENTIFICATION

MEANS BY WHICH PROBLEMS WERE IDENTIFIED

Previous studies and reports such as the Long Range Spoil Disposal Study and Environmental Impact Statements on the project maintenance of the Delaware River and Indian River Inlet, revealed many problems or potential problems in the siting and obtaining of disposal sites in the study area. A summary of the past attempts to locate alternate sites is included in the Problem Identification Appendix A. A tabular format is used there to present the status of these, which includes existing and former sites. Figures A-25 to A-27 show their locations.

Research of the dredging contract files, House and Senate Documents and permit files, has identified existing conditions, additional problem areas and data voids. Maintenance dredging quantities for active Federal navigation projects were obtained from the dredging contract files for the period 1963 to 1978. This investigation resulted in the determination of the average annual dredged quantities, by reach, for the past sixteen years and in the locations of disposal. The House and Senate Documents were researched to determine an accurate history of the active Federal navigation projects and to determine which projects have local cooperation requirements, while the Federal permit files were researched to identify the private problem data.

Other problems and areas of concern were identified by various institutions in their responses to the formal announcement of the study initiation or during coordination activities.

NATIONAL OBJECTIVES

The Water Resources Council's Principles and Standards for Planning Water and Related Land Resources specifies that the two national objectives of water resources planning are National Economic Development (NED) and Environmental Quality (EQ). These Principles and Standards also specify that the beneficial and adverse effects of each plan must be displayed in the following accounts: NED, EQ, Regional Development (RD) and Social Well-Being (SWB).

EXISTING CONDITIONS PROFILE

There are currently twenty-three Federal navigation projects in the study area. They are as follows:

Big Timber Creek, N.J.
Broadkill River, Del.
Cohansey River, N.J.
Cooper River N.J.
Delaware River at Camden, N.J.
Delaware River - Philadelphia to Sea
Delaware River - Philadelphia to Trenton
Harbor of Refuge, Del.
Indian River Inlet and Bay, Del.
Inland Waterway, Rehoboth Bay to Delaware Bay, Del.
(Lewes and Rehoboth Canal)
Little River, Del.
Mantua Creek, N.J.
Maurice River, N.J.
Mispillion River, Del.
Murderkill River, Del.

Neshaminy State Park Harbor, Pa.
Pepper Creek, Del.
Raccoon Creek, N.J.
Salem River, N.J.
Schuylkill River, Pa.
Smyrna River, Del.
Waterway from Indian River Inlet to Rehoboth Bay, Del.
Wilmington Harbor (Christina River), Del.

Since 1963 over 100 million cubic yards of material has been removed to maintain these projects. This breaks down to an average annual dredged quantity of 6.5 million cubic yards, of which 4.5 million cubic yards is from the Delaware River, Philadelphia to Sea project. The Problem Identification Appendix presents details of this removal by range and feature. Also included in this appendix are descriptions of the projects and a history of their authorizations, the responsibility for disposal sites by project, as well as project location maps indicating disposal areas and the average annual dredged quantities by range and feature.

The location maps, Figures A-5 to A-8, for the Delaware River project from Trenton to the Sea, including the Schuylkill and Christina Rivers, have the disposal areas and some of their background data shown, along with the average annual dredged quantities. The fact sheet for these disposal areas, Table 11, outlines the existing conditions. In evaluating disposal area capacity it is recognized that since lightweight shoals are involved, and since areas are subject to intermittent filling because of repetitive dredging, every three cubic yards of dredged material will only consume two cubic yards of disposal area capacity due to the consolidation of the materials. The figures in the fact sheet are dredged cubic yards.

TABLE 11

DISPOSAL AREA FACT SHEET
(active sites only)

Project	Disposal Areas	Banked Area (Acres)	Average Present Elevation of Fill 1977 3/	Average Elevation at Capacity 3/	Reason For Ultimate Elevation Limitation	1977 Capacity Remaining (MCY)	Approximate Rates of Fill (MCY/YR) 4/
Philadelphia to Sea	Artificial Island	400	10	40	Compatibility	29.0	0.04
	Killcohook	1,182	27	40	"	33.0	1.90
	Penns Neck	322	19	30	Local desires	5.0	0.50
	Penns Grove 1/	253	10	35	Compatibility	22.0	1.00
	Pedricktown	1,129	21	35	"	38.0	1.80
& Schuylkill River	National Park	115	15	40	"	6.0	0.12
	Fort Mifflin	298	19	40	"	19.0	0.475
Wilmington Harbor (Christina River)	Wilmington Harbor	160	22	35	Easements	3.5	1.00
	Edgemoor	230	34	40	"	2.5	
Philadelphia to Trenton 2/	2	65	11	21	Property owners	1.5	0.03
	4	150	14	25	agreements.	3.0	0.20
	12A	72	14	25	(sometimes	2.0	0.04
	14	21	27	35	negotiable)	0.4	0.10
	22	71	29	35	"	0.6	0.08
	24	249	14	20	"	3.0	0.15
	24D	50	24	30	"	0.7	0.20
	26	27	under water	20	"	2.0	0.10
	28	50	10	20	"	0.43	0.03

1/ Penns Grove will be ready for use around 1983, when Wilmington Harbor areas are full. The Rate of Fill will be the same.

2/ These lands are not owned by the Corps and continued use is dependent upon disposal agreement being furnished to the Corps by the State of New Jersey and the Commonwealth of Pennsylvania.

3/ Elevation referenced to Corps of Engineers Delaware River datum which is +2.901 M.S.L.

4/ The rate of fill for any disposal area will change from the initial rate when others become full and are forced to dispose material elsewhere.

Similar data is not available on the smaller, less active projects because maintenance dredging is done so infrequently that the District doesn't retain active agreements with local property owners. As such, location maps for these projects only indicate the disposal sites and the fiscal year that they were used. In some of these projects, no maintenance dredging has been done during the period from 1963 to 1978. Accordingly, no disposal areas and average annual dredged quantities are shown. However, for the Cooper River and Big Timber Creek projects in New Jersey, the locations of disposal areas used in 1962 are shown.

In regards to the non-Federal dredging problem, limited research has yielded a rough approximation of the quantities that are being dredged annually. Accurate records available on some of the non-Federal maintenance dredging show that an average of 1.8 million cubic yards per year have been removed since 1973. The remaining average annual non-Federal dredged quantity has been estimated from the Federal permit files (1963-1978) to be almost 2.0 million cubic yards per year. However, a large portion of this was not maintenance dredging, but "new work" dredging that was performed in developing the riverfront or for use as beach fill. Reflecting this, a figure of 2.5 million cubic yards would be a reasonable approximation of the total average annual non-Federal maintenance dredging being performed in the study area. Combining this with the Federal total, yields an overall figure of about 9.0 million cubic yards. It is apparent that with the performance of any new work this figure would increase. For a little more background on the non-Federal problem, see the Problem Identification Appendix.

CONDITION IF NO FEDERAL ACTION TAKEN

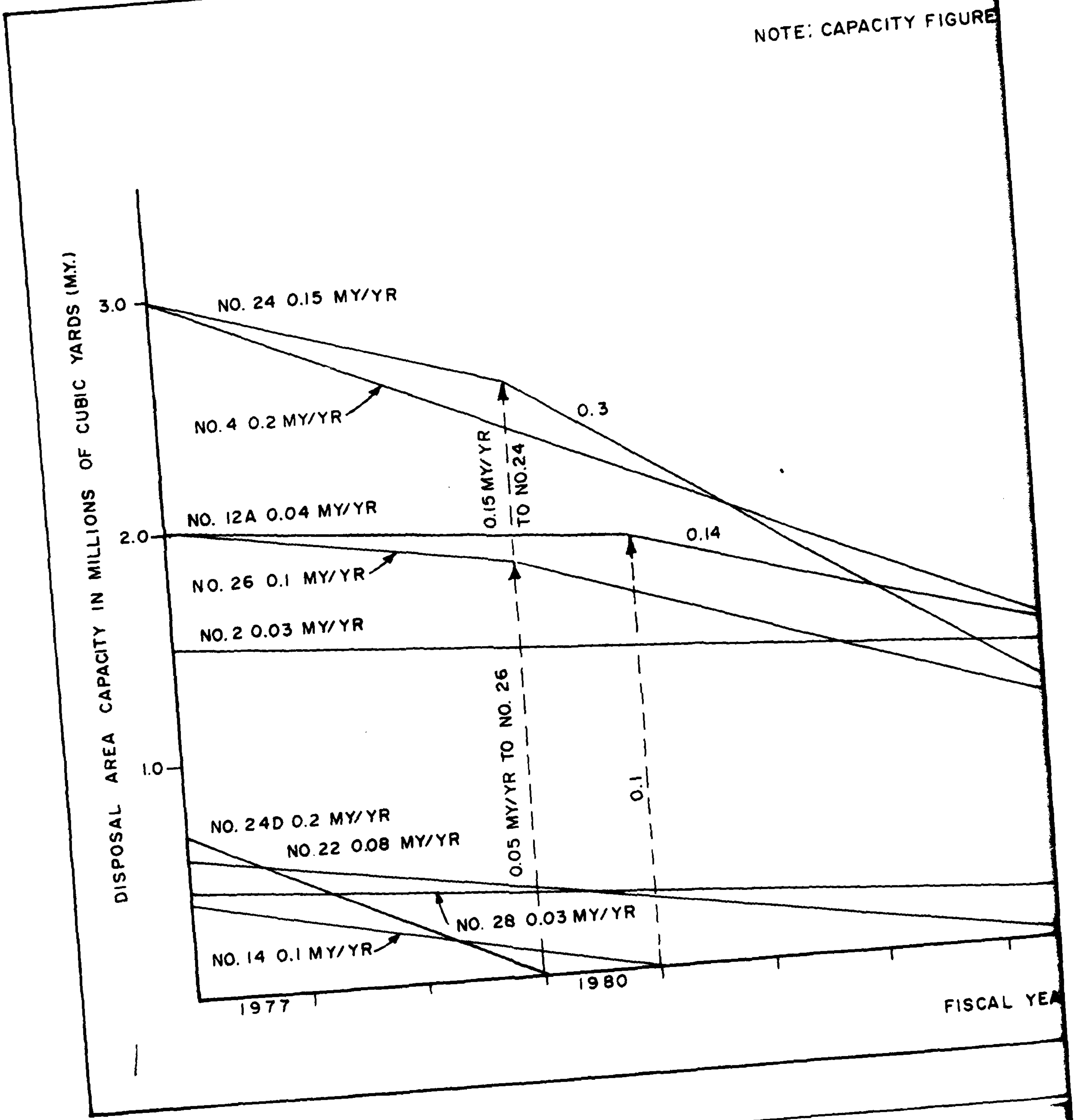
Figures 2 and 3 were drawn up using data from Table 11, to determine the remaining life of disposal areas on the Delaware River, Trenton to the Sea, without efforts to extend. The results are only rough approximations; an economic analysis would be needed to completely study the problem. The following table displays these estimates:

TABLE 12

REMAINING LIFE OF DISPOSAL AREAS
Trenton to the Sea

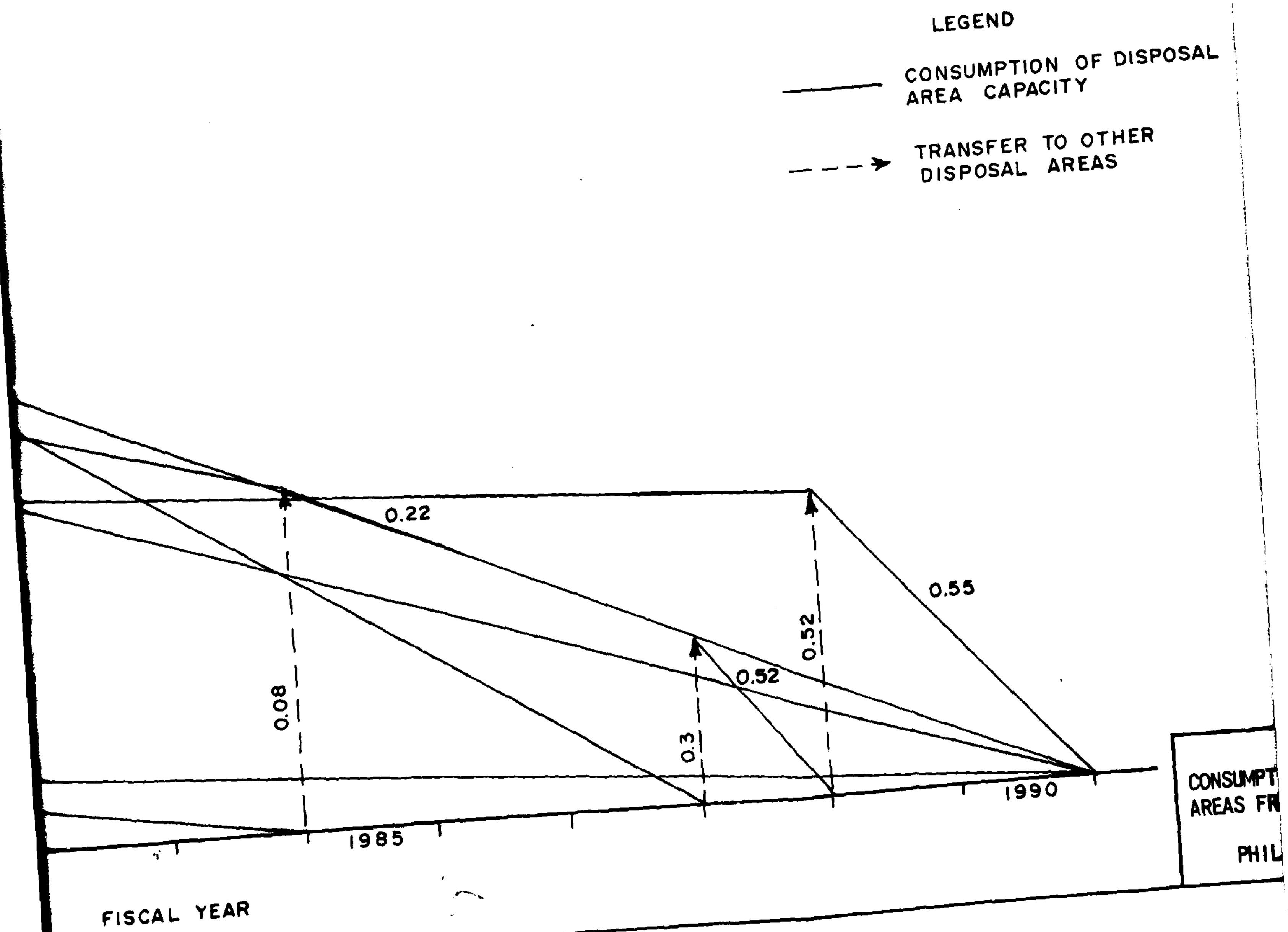
Disposal Area	Estimated FY at Zero Capacity
Artificial Island	1999
Killcohook	1988
Penns Neck	1989
Penns Grove	1994
Pedricktown	1992
National Park	1995
Fort Mifflin	1998
Wilmington Harbor Edgemoor	1983
#2	1991
#4	1991
#12-A	1989
#14	1981
#22	1985
#24	1988
#24-D	1980
#26	1991
#28	1991

Disposal areas in the Philadelphia to Trenton project should be filled to capacity around FY 1991 at which time the dredged material will be transferred to the National Park disposal area in the Philadelphia to the Sea project. Artificial Island should reach capacity about 1999,



NOTE: CAPACITY FIGURE
DISPOSAL AREA CAPACITY IN MILLIONS OF CUBIC YARDS (M.Y.)
3.0
2.0
1.0
NO. 24 0.15 MY/YR
NO. 4 0.2 MY/YR
0.3
0.15 MY/YR TO NO. 24
NO. 12A 0.04 MY/YR
0.14
NO. 26 0.1 MY/YR
NO. 2 0.03 MY/YR
0.05 MY/YR TO NO. 26
0.1
NO. 24D 0.2 MY/YR
NO. 22 0.08 MY/YR
NO. 28 0.03 MY/YR
NO. 14 0.1 MY/YR
1977
1980
FISCAL YEA

APACITY FIGURES ARE BASED ON PRESENT ELEVATION LIMITS.



CONSUMPT
AREAS FR
PHIL

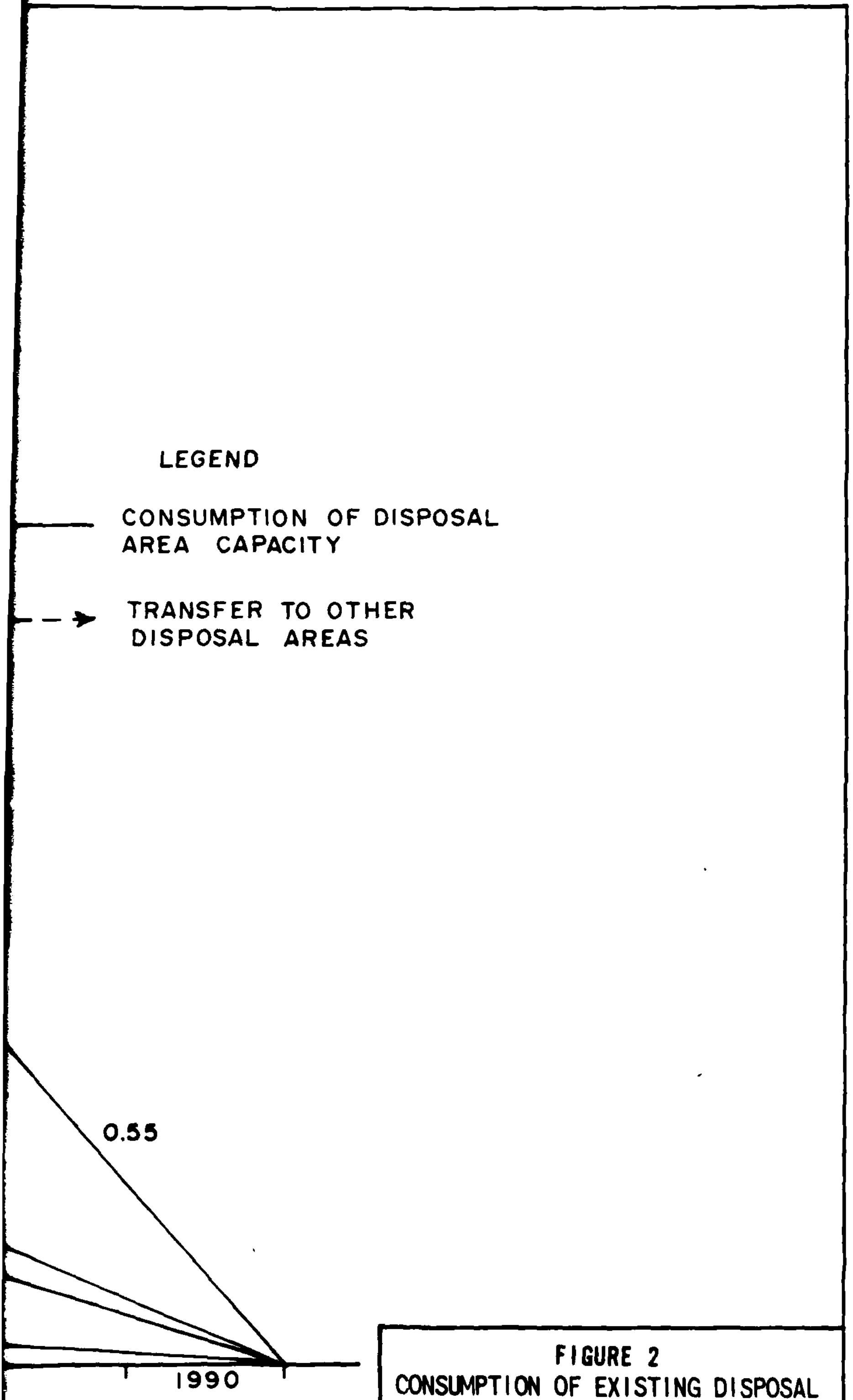
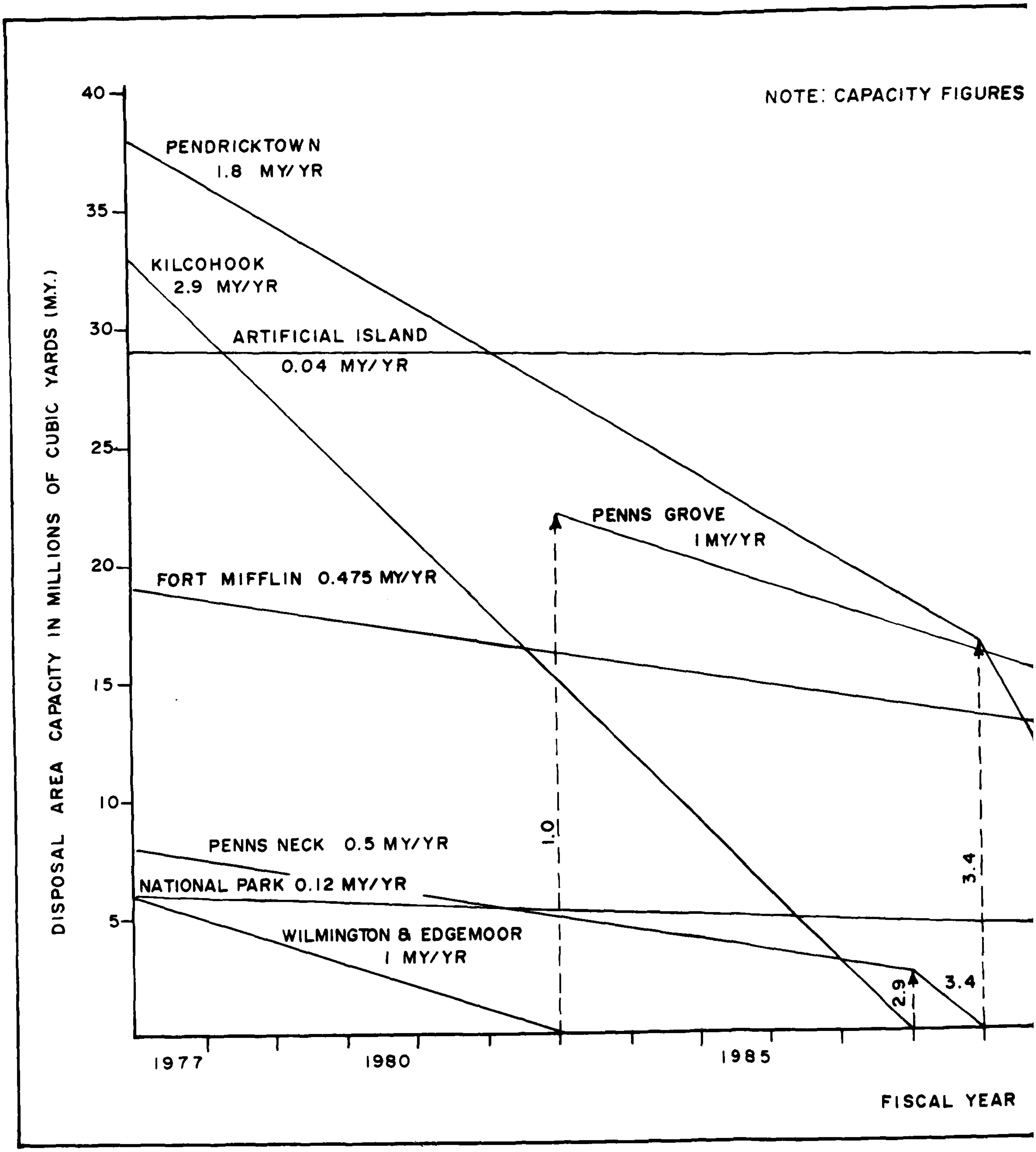
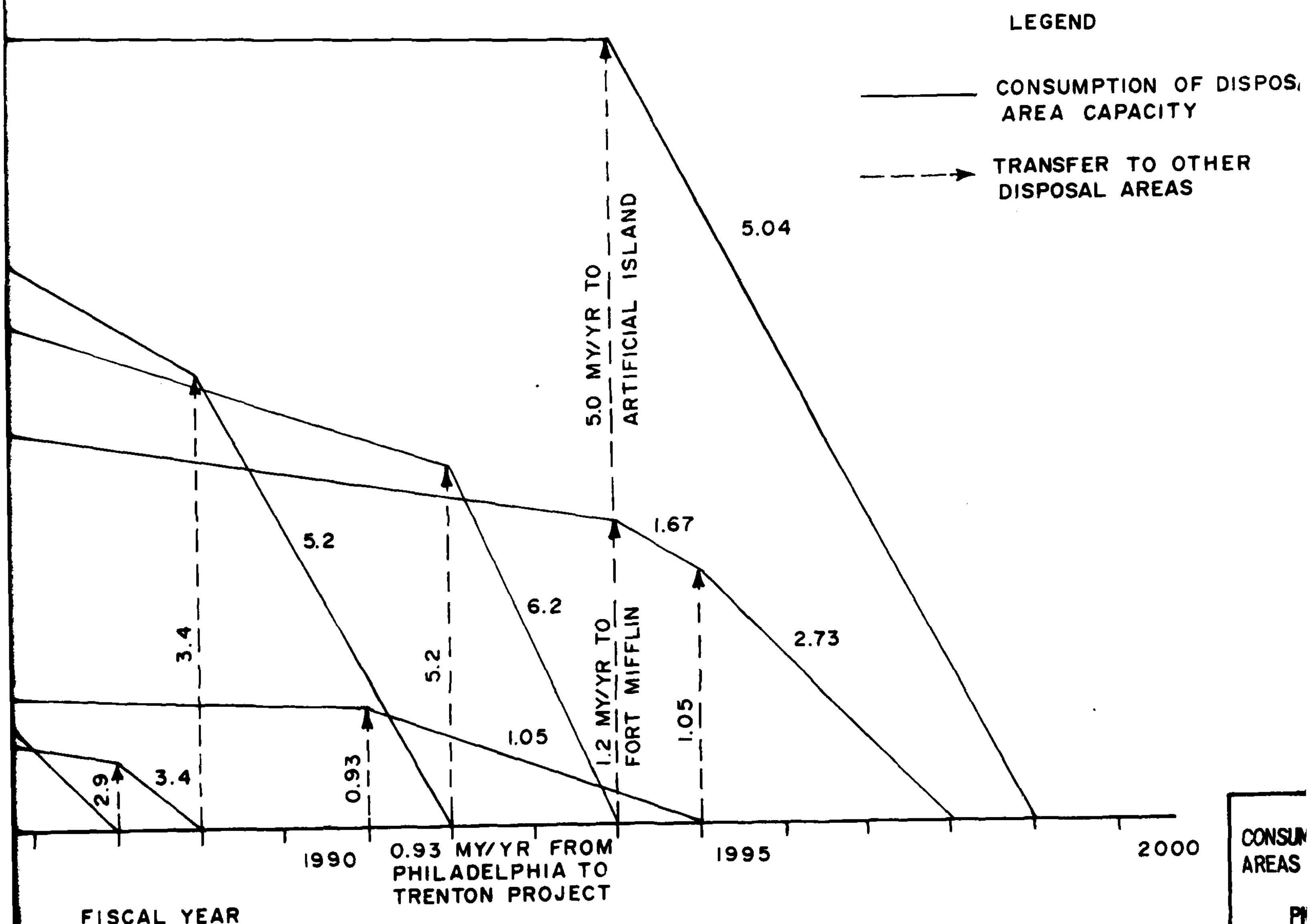


FIGURE 2
CONSUMPTION OF EXISTING DISPOSAL AREAS FROM MAINTENANCE DREDGING
DELAWARE RIVER
PHILADELPHIA TO TRENTON



NOTE: CAPACITY FIGURES
PENDRICKTOWN
1.8 MY/YR
KILCOHOOK
2.9 MY/YR
ARTIFICIAL ISLAND
0.04 MY/YR
PENNS GROVE
1 MY/YR
FORT MIFFLIN 0.475 MY/YR
PENNS NECK 0.5 MY/YR
NATIONAL PARK 0.12 MY/YR
WILMINGTON & EDGEMOOR
1 MY/YR
1.0
3.4
2.9
3.4
40
35
30
25
20
15
10
5
1977
1980
1985
DISPOSAL AREA CAPACITY IN MILLIONS OF CUBIC YARDS (M.Y.)
FISCAL YEAR

: CAPACITY FIGURES ARE BASED ON PRESENT ELEVATION LIMITS.



CONSUM
AREAS
PI

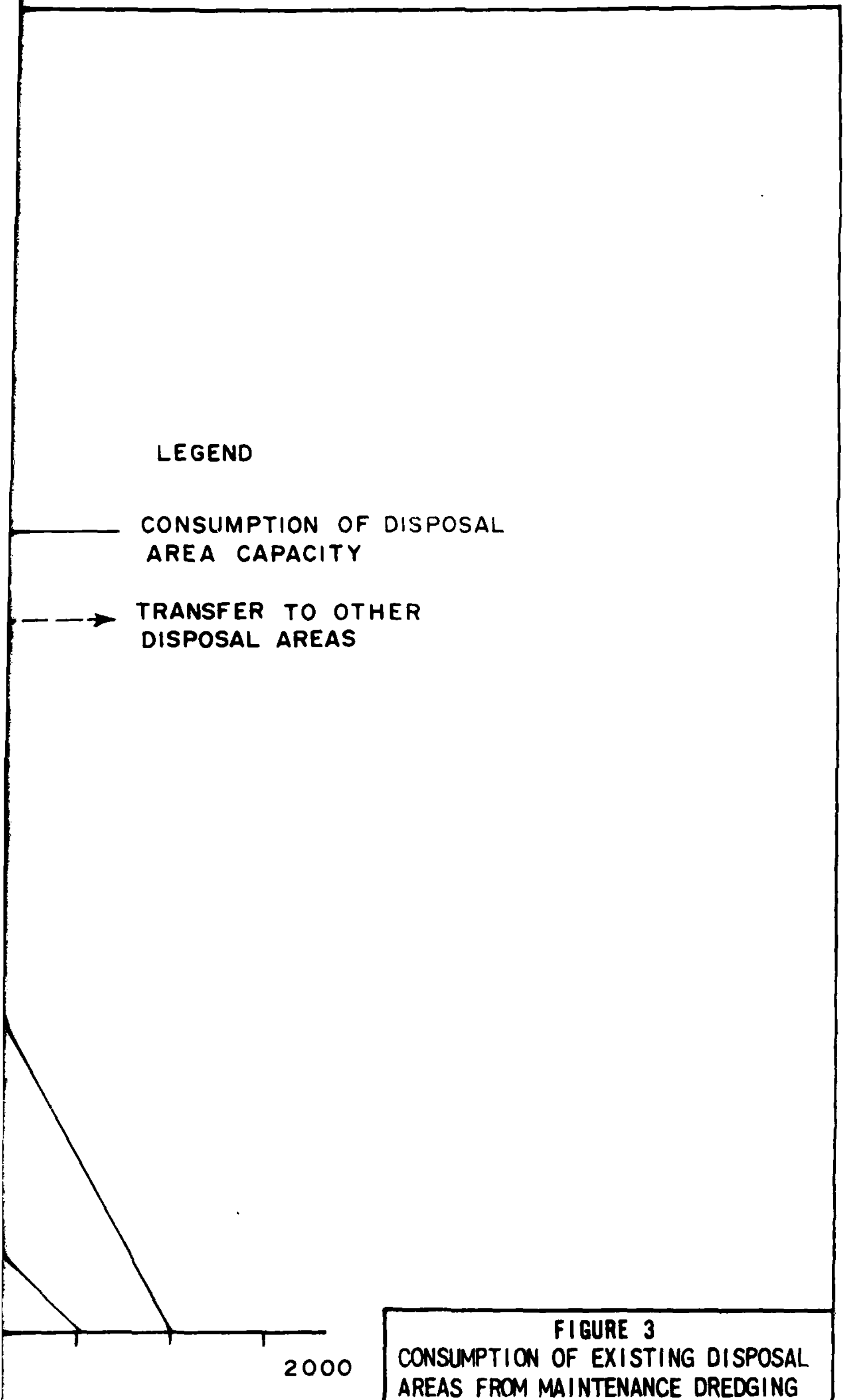


FIGURE 3
CONSUMPTION OF EXISTING DISPOSAL AREAS FROM MAINTENANCE DREDGING
DELAWARE RIVER
PHILADELPHIA TO THE SEA

at which time the entire Delaware River project including Schuylkill and Christina Rivers, will have no capacity for disposal of dredged material. Christina River (Wilmington Harbor) is the most critical project in that its disposal areas should reach capacity by 1983.

The loss of this disposal area capacity as well as that of smaller projects that do not have designated disposal areas, would result in the cessation of dredging activities for all navigation projects in the study area. This lack of dredging requires the examination of two factors. The first is a rate of shoaling of these projects; the second is the restriction of their riverborne commerce and recreational boating and fishing due to such shoaling.

Estimates of depth reduction indicate that the channel depth of 40 feet in the Delaware River will be restricted by 5 feet in 1.2 years. Examination of shipping records shows that the maximum draft of ships able to pass from the sea to Philadelphia has been 38 feet. Deeper draft vessels could navigate upriver only after lightering portions of the cargo to smaller vessels in order to reduce draft. Thus, in about fifteen months, loads from vessels in the 35 to 38 foot range would have to be transported to Philadelphia by smaller ships or other means. Three other alternatives exist. One is cargo lightering into barges in Delaware Bay. This would require additional shuttle barges, modification of the bulk handling equipment at the run terminals to accommodate the increased barges and increased transportation costs. Another alternative is a modal shift to land (rail or truck) trans-

portation, or pipeline transportation, for all of the voyage, or the final leg of the transportation system, depending on origin of the commodity. The third additional alternative would be abandonment of riverside plants, and relocation to deep water ports where larger ships can be accommodated. Costs would be severe.

All four of the alternatives exact economic penalties, both on the immediate geographic region bounding the river and on the region which is supplied with processed commodities by the industrial complex that is located along the waterfronts of the study area. Barges are competitive with shipping in terms of direct costs per ton-mile, but the incremental costs of trans-shipment usually make such a system non-competitive except in special cases.

Philadelphia to Trenton traffic includes approximately 50% fuels and 30% iron ores and concentrates. The steel plants in the Morrisville area are tied to a specific transportation system that depends on ships in the 37 to 38 foot draft range. Channel depth reduction would halt this operation. The economic regional secondary effects of such a change in operations would be major.

Although much traffic exists in smaller-draft ships, the basic industries of the region depend on bulk carriers of 35-foot draft and greater. Limitations on these drafts would have far-reaching effects on the economy of the entire middle-Atlantic region. The difficulties of establishing a major trans-shipment point in the bay, for example,

have been brought to light during recent proposals to establish such a facility for outbound coal and inbound ore. There is a larger possibility of achieving a modal shift for commodities of domestic origin, but even so the transport of low-value bulk commodities over long distances remains most economical by sea.

The example cited here is a short-term situation of about six or seven years. If dredging of the projects in the study area were discontinued for a more extended period, the effects would be much greater. This would be equivalent to a major disruption of the transportation system supplying the area. Any disruption in dredging activities would also affect ship safety. Channel restrictions resulting from reduced drafts and other channel limitations due to siltation, combined with increasing traffic and a trend to larger vessel size will cause the hazardous conditions.

Cessation of periodic rock removal operations would, in conjunction with the trend for larger draft vessels, result in a return to pre-project conditions. The inability to effectively maintain adequate depths along the Marcus Hook Range of the Delaware River would result in deep draft vessels hitting the obstructive pinacles. While such action would not have the same disruptive effects as the discontinuance of maintenance dredging, delays in travel and restrictions in maneuvering and depths would result.

Due to the fact that Indian River Inlet and Bay and other inland waterways are void of much commercial development, the effect of the cessation

of dredging would mostly be felt in the recreational boating and fishing activities. Non-maintenance of the navigation channel would result in a shallow passage across the tidal delta within Indian River and Bay, and increase navigational hazards considerably. Increased loss of life and property would probably occur. The bay would probably lose some of its attractiveness as a recreational resource. This same sort of affect would indoubtedly be felt along some of the other projects in the study area.

PROBLEMS, NEEDS, AND OPPORTUNITIES

The problems which resulted in the adoption of the study resolution are multi-casual. The major problems that have been identified thus far are listed below:

a. The once vast tidal marsh areas along the Delaware estuary, traditionally used as disposal sites have rapidly disappeared to development.

b. Strong objections from fish and wildlife interests to the use of the remaining marsh areas for spoil disposal sites.

c. Increased local opposition to the acquisition of marginal farmlands for disposal sites.

d. Environmental awareness and protection policies by the States within the estuary, particularly with regard to wetland, dredging and filling.

e. The economic welfare of the Delaware Valley is dependent upon the maintenance of its deepwater navigation facilities. To maintain navigation in all the projects of the study area requires an average annual removal and disposal of over 9,000,000 cubic yards of material.

f. Demand for disposal sites has increased as the size and number of navigation projects in the tidal Delaware has increased with the associated increase in dredging quantities.

g. The apparent undesirability of dredging spoil for landfill material due its high silt content.

h. Impact of private sector dredging activities. As a result, the attainability of suitable disposal sites will most likely prove very difficult once existing sites are filled to capacity. As mentioned earlier, three potential disposal areas, Chester Monds Island, Goose Island, and Tinicum Island were identified during the Long Range Spoil Disposal Study that was completed in 1969. However, there is a low level of confidence that any of these sites could ever be obtained.

Other problems that are associated with dredging disposal have been identified, they are:

a. Surface water, groundwater and sediment quality.

b. Mosquito control.

c. Recreation.

d. Additional port development or potential future conditions.

e. Institutional, i.e. furnishing of sites, monitoring, development, etc.

Because of the regional nature of the study and the extent of the problem, the opportunities will exist for all concerned interests and institutions to take an active part in its resolution.

PLANNING CONSTRAINTS AND POLICY ISSUES

The formulation and evaluation of alternative plans including screening of these alternatives must of necessity be constrained by an appropriate set of technical and economic criteria. They are further constrained by environmental awareness policies.

Technical Constraints. One technical constraint is provided by the limitations of dredging techniques. While the dredging operation itself will not directly affect the disposal site selection, the dredging techniques and transport methods used to carry the materials from the excavation area to the disposal sites will pose certain constraints. Table 13 on the following page, details the appropriate constraints.

An additional technical constraint is imposed by the allowable heights of fill at each disposal site. The initial and ultimate height of a disposal facility overall depends on a number of factors including the volume of material to be dredged over the time span of operations, the requirements for a single or incremental dikes, the aesthetic compatibility of high disposal facilities with the surrounding natural and man-made environment, and future site use. Table 11 in the Existing Conditions section, details the average elevation for the capacity determination at each active Federal disposal site and the reason for the ultimate elevation limitation.

TABLE 13

DREDGING CONSTRAINTS

Dredging Techniques	Principle Operation	Flexibility of Disposal Method
Hydraulic Pipeline	Used universally except in areas of heavy navigation.	Continuous operation, floating pipeline; point of access varies from a fixed station to multiple random points of access along disposal area or retention structure.
Hopper with direct pumpout or bottom dumping barge	Used principally in waters where pipelines would interfere with navigation.	Dredged material contained in hopper placed in rehandling basin or direct pumpout into retention structure through pipeline from fixed point alongside disposal site.
Mechanical: dipper clamshell, bucket	Used principally on very small jobs and in areas unsuitable for pipeline or hopper.	Sediments are dredged into scows and transferred to site handling basins.

Economic Constraints. Constraints on disposal site location are placed by the dredging techniques with regard to the limits of use. The following table details these.

TABLE 14

ECONOMIC CONSTRAINTS

Dredging Technique	Maximum economical distance to disposal site; General cost considerations
Hydraulic Pipeline	5+ miles with use of booster pumps; operations generally large-scale and cost-efficient.
Hopper	Slight limitation on distance; slower and less continuous project executions.
Mechanical	Slight limitation on distance; slower and less continuous project executions; economically suitable for small dredging projects.

It has been the Philadelphia District policy to attempt to locate disposal areas as close as possible to dredging areas in order that maintenance dredging can be performed as efficiently as possible. Dredging costs rise as the distance between dredging and disposal areas increases since, in the case of hopper and hydraulic pipeline dredging, the production rate of the dredge will decline, and for bucket dredging, more scows are required to keep the dredge operating. Limits (as of December 1978) as they apply to projects are as follows:

a. Delaware River, Philadelphia to the Sea - Most of the maintenance dredging performed for this project is by hopper dredge with direct pump-out of the dredged material to upland disposal sites. With regards to disposal area location, there are two factors which affect the economics of hopper dredging: haul distance from the dredging location to the mooring barge and the pumping distance from the mooring barge to the disposal area. Government-owned disposal areas currently utilized for this dredging are located near the recurring shoal areas (Philadelphia Harbor, Marcus Hook, New Castle and Deepwater Point Ranges) and are also located on or near the river front. The currently available disposal area located most distant from recurring shoal areas is Artificial Island. At the present time, any haul of dredged material downriver of Artificial Island would increase dredging costs. With regard to pumpout distance, it is considered that the maximum capability for existing equipment is 15,000 feet and possibly up to 20,000 feet for very light material.

b. Delaware River, Philadelphia to Trenton - Dredging of this project is normally performed under Government contract by hydraulic pipeline dredge. The maximum efficient pumping distance for the size dredge normally used for this work (20"-27") is considered to be 20-25,000 feet.

c. Schuylkill River - Dredging of the 33-foot channel is normally performed by hydraulic pipeline dredge (20"-27"). The maximum efficient pumping distance is considered to be 20-25,000 feet. Dredging of the 26-foot channel is normally done by bucket dredging with the Corps making available to contractors the Mantua Creek Rehandling Basin and National Park Disposal Area. For FY 1978 dredging, however, the contractor has elected to use a hydraulic pipeline dredge for the 26-foot channel. This involves a maximum pumping distance of about 25,000 feet.

d. Wilmington Harbor - This project is normally dredged by hydraulic pipeline dredge (20"-27") under Government contract. Maximum pumping distance is considered to be 20-25,000 feet.

e. Other small projects - All other projects would normally be dredged by small (12") hydraulic pipeline dredge. The maximum efficient pumping distance for this type of dredge is considered to be 3-5,000 feet.

The most appropriate economic constraint on a Federal navigation project is the benefit to cost ratio, a measure of economic efficiency. Accordingly, the limit on pumping distance can very well vary from project to project.

Constraints Due to Environmental Awareness and Other Policies. The Institutional Analysis Appendix discusses the institutions in the study area and identifies the policies that they implement. These policies are ones that could have an affect on a regional dredging spoil disposal plan. A brief discussion on how some of these policies have impacted Philadelphia District's procedures, is presented in the Problem Identification Appendix.

PLANNING OBJECTIVES

Satisfaction of national objectives is not achievable in an individual planning study unless they can be related to the specific goals of the study. The goals of the Delaware River Dredging Disposal Study will be to:

a. Develop a regional dredging disposal plan for the Delaware River, its tidal tributaries and Delaware Bay, Indian River Inlet and Bay; and,

b. Designate specific sites which may be used on a short-term basis, with minimum degradation of the natural environment, by both the public and private sectors for the disposal of dredging material and the identification of potential sites which may be used for this purpose thereafter.

The planning objectives which will guide this study's efforts and which will be the basis for evaluation and for measuring study accomplishment are as follows:

- Identify potential disposal sites and disposal techniques.

- Identify and examine alternatives available for use of dredged material.

- Minimize degradation of the natural environment.

- Determine land uses in the estuary.

- Develop recreation where appropriate.

- Protect existing fish and wildlife resources.

- Develop procedures for assuring an appropriate level of public participation.

CHAPTER IV

STAGE 1 FORMULATION

PLAN FORMULATION RATIONALE

Plan formulation meetings for the study were held at the District office on February 26 and 27, 1979. The purposes of the meetings were to review alternate solutions to the dredging disposal problem, determine possible impacts, and plan evaluations and determine study needs. Those attending the meetings included personnel from the Corps' Dredged Material Research Program at WES; U.S. Department of Interior, Fish and Wildlife Service; U.S. Department of Commerce, National Marine Fisheries Service; the District's consultant for environmental analysis and evaluation; as well as members of the District's dredging disposal study committee.

MANAGEMENT MEASURES

The alternative plans which were considered in Stage 1 include:

a. Dewatering of disposal sites.

b. Increased height of containment dikes at disposal sites.

c. Lease extention.

d. Reuse of dredged material, which includes

- filling strip mines/land reclamation
- highway fill
- beach nourishment
- agricultural soil enrichment

- brick making
- resource recovery
- habitat development
- mine native soil, fill with dredged material, and replace overburden

e. Reduce dredging activities, which includes

- use of management techniques
- reducing scope of work

f. Reduce shoaling by use of deposition basins.

g. Reduce sediment erosion.

h. Better management of sites.

i. Acquisition of new upland sites, which includes

- long distance (up to 100 miles)
- short distance

j. Open water disposal of dredged material, which includes

- ocean and estuarine dumping
- shallows development (fill to just below MLW)
- marsh development
- island development
- upland creation from island or "peninsula" development

Alternatives a. through h. represent methods to extend the useful life of existing dredge disposal sites. Alternatives i. and j. represent methods to obtain additional sites for dredging material disposal.

a. Dewatering of disposal sites. The Waterways Experiment Station (WES) has closely examined dewatering of disposal sites through the Dredged Material Research Program (DMRP). The most cost effective method of dewatering is through use of the Riverine Utility Craft (RUC). This vehicle improves drainage by surface trenching of the disposal areas. The trenching would be done for each layer of dredged material deposited. Using the RUC after deposition of several feet of material would result in minimal dewatering of lower dredge material layers.

b. Increased height of disposal site containment dikes. Disposal area dikes are generally raised periodically to accommodate increased volume. The height increase should be based on engineering considerations including slope stability and existing subsurface conditions. Final dike elevations in privately owned sites is usually controlled by an easement. Final dike elevations in government owned sites are usually influenced by safety considerations and future land use. Safety considerations can be assured through good engineering design and construction, and when necessary, restriction on the rate of height increase.

c. Lease extension. Many disposal sites are under pressure by local interests to release the sites for enhanced uses. Lease extension represents a viable alternative to those sites with a high volume capacity.

d. Reuse of dredged materials. Dredge material is usually well graded with sizes ranging from fine silts to coarse gravel and even small stones. Very fine material would be of a poor quality for reuse and could be segregated out. The remaining material could be applied to a wide variety

of uses including land reclamation, highway fill, beach nourishment, agricultural soil enrichment, brick making, fill material at excavation site, a recoverable resource of commercial sand and gravel, and as material for use in developing fish and wildlife habitats.

The Philadelphia District is currently utilizing all known methods of extending the useful life of disposal areas, including the sale of material from those areas where a market exists. In addition, it is obvious that in light of present environmental considerations and commercial development along the shores of the Delaware River, we must continue use of our existing sites to their maximum. The following table lists the sales of fill material from active disposal sites since 1969.

TABLE 15

SALES OF FILL MATERIAL

FY	Disposal Site	Quantity (c.y.)
1969	Fort Mifflin	100,000
1972	Killcohook	25,000
	Penns Neck	25,000
1973	Pedricktown North	300,000
	National Park	116,000
	Fort Mifflin	250,000
	Penns Grove (site not yet used)	30,000
1974	Penns Grove (site not yet used)	4,603,000
	National Park	93,000
	Penns Neck	25,000
	Pedricktown North	30,000
1976	Pedricktown North	1,032,000
1977	Fort Mifflin	38,000

e. Reduce dredging activities. Dredging in the study area is important to maintain both commercial shipping and recreational boating activities.

A reduction in dredging activities would require an analysis of the economic needs for each dredging activity and the feasibility of reducing dredged channel dimensions and/or the frequency of maintenance dredging. The dredging of additional areas would be permitted only if a sufficient need exists and additional disposal sites could be provided.

f. Reduce shoaling by means of deposition basins. The use of deposition basins to curtail dredging would be applicable to areas where the characteristics of the shoal material permit the construction of a deposition basin and the movements of the shoals are well known.

g. Reduce sediment erosion. Erosion control to reduce the sediment load carried by streams and rivers has been a continuous, long standing effort by the U.S. Department of Agriculture, Soil Conservation Service and other regional, State, and local organizations. Strict sediment control regulations are also in force for all construction activities. Check dams, sedimentation traps, vegetal cover on open lands, stream bank stabilization by revetment, vegetation or other bank stabilization controls, and other sedimentation control measures can be used. Additionally, erosion control of agricultural lands can be accomplished by terracing, contour plowing, strip cropping and similar techniques.

h. Better management of sites. Management practices should be intensively geared to extend the capacity and useful life of existing dredged material disposal areas such that the need for new dredged material disposal areas is kept to a minimum. These management practices include

close supervision of dike and outflow facilities design, construction, and maintenance, and efforts to assure expeditious drainage of dredged material.

i. Acquisition of new upland sites. The acquisition of new upland sites for dredged material disposal includes sites that are both short distances and longer distances (up to 100 miles) from the dredging site. Short distance sites are primarily older sites which have not been utilized for several years. The present condition, capacity, and suitability for reuse should be examined. Long distance sites would include upland strip mines, abandoned quarries, sand, gravel and clay pits or deep shaft mines. Dredge material could be trucked inland to the sites or carried on railway cars. A permanent pipeline system with rehandling basin could also be constructed.

j. Open water disposal of dredged material. Open water disposal could be performed in both ocean and estuarine areas. Disposal would be done to develop shallows, marsh, islands and upland areas. Marsh creation is needed in many portions of the study area, especially along the Delaware River from Philadelphia to Trenton. Marshes could be created through open or confined disposal with fine grained material requiring confinement. Grasses would be planted on the site for stabilization and habitat development. The creation of the marsh would be staged over a period of years. New shallows could be created in a similar fashion, however dredge material would be placed to an elevation just below local Mean Low Water. In-shore shallows areas are necessary for their use as

spawning and nursery areas for fish and shellfish while offshore shallows areas would be used as shellfish beds. Island and upland development coupled with habitat development techniques could provide suitable wildlife management areas.

IMPACTS OF ALTERNATIVE PLANS

The existing setting of the study area will be affected by the implementation of any of the alternative plans. The environmental and socio-economic impacts have been generically identified and will be further examined in subsequent stages of the study. These impacts are listed below.

a. Dewatering

- Actual reduction in capacity depends on material type; silt doesn't consolidate well.
- Positive environmental features.
- Material is made more suitable for productive uses.

b. Increasing height of containment dikes

- Aesthetics impact depends on location.
- Increase in erosion.
- Encroachment due to dike face slopes.
- Cost increase because of pumping to greater heights.
- Safety considerations due to increased heights and a possible water buildup.
- Positive environmental impact because less new areas would be needed.
- Negative impacts on future industrial land use.

c. Lease extension

• Would involve positive management efforts but could have negative impact on local land use.

• Much pressure has been exerted on the Corps to release present disposal sites.

d. Reuse of material

• Material type will dictate the use and the impacts.

• Positive environmental impact because less new areas would be needed.

• Cost increase in disposal if transporting material inland for reuse.

• For beach nourishment the quality of material is of concern for possible pollution of beaches; could have negative impact on fish spawning; positive impact due to reduced construction costs; some beaches may be too distant from dredging sites.

• Resource recovery could have negative impacts on firms in the sand and gravel business.

• Possible positive impact on employment.

• Some material may not be suitable for construction purposes, such as highway fill.

• Brick making may be excessively costly.

• Filling of strip mines could contaminate groundwater.

• Limited nutrient value for agricultural use.

e. Reduce dredging

• Negative impact on Commerce/Economy.

• Negative institutional aspects.

• Positive environmental impact.

f. Reduce shoaling by use of deposition basins

- Using deposition basins could cause negative environmental impacts.
- Positive in reducing scope of dredging activities to local areas.
- Depth would be limited by location of rockline.

g. Reduce sediment erosion

- Could be positive over long term, but probably outside Corps jurisdiction.

h. Better management of sites

- Volume potential is small.

i. New upland sites

Short distances:

- Shore stability of concern.
- Aquifer recharge areas of concern.
- Disposal is less costly when located along the river or near dredging areas.
- May necessitate use of existing marshland with associated negative impacts.

Long distance:

- Trucking material would place too much traffic in an area.
- Cost increase in long distance disposal because of transportation.
- Possible impounded water in quarry is of concern.
- Leaching into nearby streams and groundwater.
- Problems exist in rights-of-way for permanent pipeline system.
- Want to avoid inland wetlands.

- Returning effluent from a distance is a problem.
- For utilizing landfills, which operate continuously, dredged material could only be stockpiled or transferred from existing sites to avoid interfering operations.

j. Open water disposal of dredged material

- Commercial fisheries such as surface clam and ocean cohog are of concern.
- Soil compatibility is important.
- Possible effects of sediment transport and shoaling patterns.
- Match spoil characteristics with local sediment for minimal effects on benthic animals.
- Avoid areas where spoil would be carried downstream onto shellfish areas. Also avoid oyster planting grounds, hard clam beds, blue crab dredging areas, lobster fishing areas, and submerged grass beds. Shellfish are important commercially as well as for waterfowl uses, namely duck and geese.
- Favorable impacts of marsh creation and habitat development provided other important habitats are not destroyed in the process.

STAGE 1 CONCLUSION

Some efforts have been made in the past, under the District's Operation and Maintenance program, to extend the life of existing sites and to obtain new upland sites. However, no detailed documentation exists on any procedures that may have been used in selecting alternative plans. There is a need to document the results of these past efforts by the District. Therefore, all alternatives will be carried forward into

Stage 2 to more formally document attempts at extending the useful life of disposal areas and to more formulatively analyze potential new sites.

Stage 2 efforts will also require the Philadelphia District personnel and other involved agencies to become familiar with the methods developed by the DMRP that evaluate the relative impacts of alternatives. There is no single disposal alternative that presumptively results in impacts of such nature that it can be categorically dismissed from consideration. This holds true for open water disposal, confined upland disposal, or any other alternative. In addition, reports by other parties will also be researched and reviewed to further define the alternatives and their impacts.

All these efforts, along with the creation of a computerized spatial analysis system, would allow the suitability assessment and development of a set of regional dredging disposal plans by the culmination of Stage 2.

CHAPTER V

VIEWS OF CONCERNED INTERESTS

Formal announcement of the study initiation was sent to all known interested parties on 23 February 1978. Questions or problems identified from responses to that notice are summarized in Tables 16 and 17. Other significant comments and views of agencies can be found in the "Other Studies" section of Chapter I, in regards to various environmental impact statements.

Also worth citing are some views expressed by U. S. Fish and Wildlife Service personnel at the preliminary plan formulation meetings:

- They would like to see the emphasis placed on prolonging existing sites and possible long range transport to inland areas.

- They would particularly like to see new wetlands created between Philadelphia and Trenton.

TABLE 16

QUESTIONS OR PROBLEMS IDENTIFIED FROM
RESPONSES TO STUDY INITIATION NOTICE

Agency	Date	Questions/Problems
City of Phila. Water Department	28 Feb 78	Impact to water supply at Torresdale plant - turbidity.
City of Camden; Division of Economic Development	6 Mar 78	May have suitable spoil disposal sites.
Camden County Planning Dept.	9 Mar 78	Findings of 208 and SNJWRS may have applicable data; OCS study and Delaware River waterfront communities district planning project could serve as public participation element.
Bucks County Planning Commission	7 Mar 78	Disposal sites.
Delaware Dept. of Community Affairs and Economic Development	9 Mar 78	Interested in participating; encouraging development of breakwater harbor and Port of Wilmington.
Bucks County Conservation District	10 Mar 78	Preservation of agricultural lands.
Delaware County Planning Dept.	9 Mar 78	Use data submitted for Chester Creek Study.
Pa. Dept. of Environmental Resources	10 Mar 78	Unavailability of new spoil disposal areas to be provided.
Delaware Division of Historical and Cultural Affairs	13 Mar 78	Impact of disposal on cultural resources; contact for data.
Delaware Div. of Fish & Wildlife	7 Mar 78	Conservation of Fish and Wildlife habitat.
Cape May County Planning Board	15 Mar 78	Utilization of dredge spoils on beaches of lower Cape May County; Cape May Canal.

TABLE 16 (Con't.)

QUESTIONS OR PROBLEMS IDENTIFIED FROM RESPONSES TO STUDY INITIATION NOTICE

Agency	Date	Questions/Problems
DRBC	15 Mar 78	Include requirement of private sector; include Delaware Estuary Waste Treatment Plant sludge.
Pa. DER; Bureau of State Parks	16 Mar 78	Include Neshaminy State Park Marina project.
DVRPC	21 Mar 78	CZM Plan has identified areas for spoil disposal; Steering Committee role.
WES	21 Mar 78	Dredging Operations Technical Support (DCTS) team for assistance in implementing study.
NJ Dept. of Transportation	18 Apr 78	Possible use for NJ DOT construction projects; suitability for load bearing; cost efficiency against nearby upland borrow pits; time frames; adverse public acceptance; soils data; agreements for use.
NJ Dept. of Transportation	8 May 78	May require fill in the general Trenton complex area.
City of Wilmington	3 Apr 78	Create land at Port of Wilmington (Cherry Island).
U.S. Fish & Wildlife Service	22 Jun 78	Investigate methods which reduce sediments to the river; terminate study of training dikes; address relocation of navigation facilities; investigate reuse of spoil material; investigate marsh creation; terminate plans for Goose Island, Chester-Monds Island, & Tinicum Island; locate environmentally acceptable inland disposal sites.

TABLE 16 (Con't.)

QUESTIONS OR PROBLEMS IDENTIFIED FROM
RESPONSES TO STUDY INITIATION NOTICE

Agency	Date	Questions/Problems
U.S. Department of the Air Force	19 May 78	Disposal site near Dover AFB would attract birds and increase bird/aircraft strike hazards.
U.S. Geological Survey	16 Mar 78 (FonCon)	Concerned with impact of proposals on groundwater quality. Consider all potential solutions, not just identify new sites.
Delaware Basin Fish & Wildlife Management Cooperative	24 Aug 78	Effects of bucket dredging and overboard disposal on migratory fish.

TABLE 17

QUESTIONS OR PROBLEMS IDENTIFIED FROM
RESPONSES TO STUDY INITIATION NOTICE

Group	Date	Questions/Problems
Dorchester Industries, Inc.	3 Mar 78	Preserve ecological balance in Lower Delaware Bay.
Anchorage Marina (Essington)	2 Mar 78	Lack of dredging.
Township of Mount Holly	6 Mar 78	Rancocas Creek needs dredging; use spoil for fill in various parks.
Camden Board of Education	6 Mar 78	Use materials to build up banks of Newton Creek and Cooper River to eliminate flooding.
Society of Natural History of Delaware	26 Feb 78	Don't place dredge spoil in wetlands; place in high ground; need sediment retention; reuse material.
Bensalem Township	9 Mar 78	Flooding of Neshaminy Creek, Poquessing Creek and Delaware River; object to dumping in HUD flood plains.
Township of Delran	15 Mar 78	Problems with critical areas along Delaware.
National Audubon Society	14 Mar 78	Desire to work with study.
Conrail	20 Mar 78	Dredging and spoil disposal are items of continuing expense to their waterfront installations.
Township of Cherry Hill	21 Mar 78	Consider composting spoil material with sludge and leaves.
Greenwich Township	16 Mar 78	Oppose dredge spoils in Repaupo Creek Watershed.
Yapewi Aquatic Club	29 Mar 78	Include dredging requirements of Crosswicks Creek.

TABLE 17 (Con't.)

QUESTIONS OR PROBLEMS IDENTIFIED FROM
RESPONSES TO STUDY INITIATION NOTICE

Group	Date	Questions/Problems
Corinthian Yacht Club	28 Mar 78	Siltation behind Tinicum Island; experimental approaches.
Bridgeport Boat Yard	Mar 78	Repair jetty at Raccoon Creek to reduce dredging.
Wildlife Management Institute	28 Mar 78	Use dredge spoil to develop new marsh lands and restore lost wetlands.
University of Delaware, Department of Civil Engineering	6 Apr 78	Use dredge spoil for offshore Industrial Port Islands.
New Castle County Department of Parks and Recreation	6 Apr 78	Use Fox Point Park as a disposal site.
Council of Civic Organizations of Brandywine Hundred	23 Apr 78	Use Fox Point Park as a disposal site.
Fort Delaware Society	21 Apr 78	Heronry on Pea Patch Island; oppose use of Pea Patch Island as a site.
Rutgers University	18 Apr 78	Mosquito control on dredge spoil disposal sites.
Delmarva Advisory Council	25 Apr 78	Consider shoaling at fishing ports along Delaware Coast.
University of Delaware, College of Agricultural Sciences	17 May 78	Two departments have expertise in spoil disposal.
DuPont Chambers Works	5 Jul 78 (FonCon)	Unavailability of disposal areas in future.

CHAPTER VI

STUDY MANAGEMENT

INTRODUCTION

The planning process employed in the study will be consistent with the Water Resources Council's Principles and Standards. The Corps' water resources planning guidelines (ER series 1105-2-2XX and related regulations) will be followed in conducting the study. The study planning process will be an iterative one consisting of four functional tasks: problem identification; formulation of alternatives; impact assessment; and evaluation of alternatives.

The initial iteration of the planning process (Stage 1) has been completed and the results are presented in Chapter IV. From initial screening, alternatives were identified to be evaluated in future iterations of the planning process. From this nucleus, other plans which attempt to address a mix of the study's planning objectives, will be identified. A National Economic Development (NED) plan and an Environmental Quality (EQ) plan will be developed.

As can be seen on the study cost estimate and network, the heaviest emphasis is being placed on Stage 2. In progressing through the iterations of Stage 2, efforts will become more detailed in order to accurately determine the suitability of the specific sites to the various alternative plans. The resultant of Stage 2 will be a "software package" of suitable regional plans for the study area, since primary

responsibility of sites rests with local interests.

Stage 3 will provide an opportunity to go through a final iteration on the Philadelphia to Sea project where provision of disposal areas is a Federal responsibility and present the potential regional plans for selection by non-Federal sponsors.

WORK PACKAGES

This section provides brief descriptions on the tasks that will be required in Stages 2 and 3. The costs for each task, by stage and by Fiscal Year (FY), are presented in Appendix F on Engineering Form 2204 (PB-6) and Table F-1, respectively.

Public Involvement. Stage 1 efforts in public involvement have included coordination with various institutions as well as the preparation of numerous detailed project maps for display purposes at meetings.

An attempt will be made in Stages 2 and 3 to establish and maintain a continuous dialogue between the planners and the affected and interested agencies, groups, and individuals. The public involvement program will be employed to:

a. Identify, inform and involve all interested publics with emphasis on those likely to be impacted by any alternative plans;

b. Foster a climate of understanding and trust among all parties in the planning process;

c. Encourage the resolution of conflict among various interests in the planning process; and,

d. Assist decision makers by providing them with useful information and current public views.

The public involvement program itself will be carried out with the use of four basic tools: information bulletins published throughout the course of the study, workshop meetings, public meetings, and continuous informal meetings and contacts with agencies, groups and the general public who are actively involved in the study.

Three major groupings of affected publics have been identified. These are: first, agencies and organizations concerned with dredging and dredge disposal; second, agencies and organizations concerned with environmental, historic, cultural and community preservation; and third, the general public. All publics will be encouraged to participate and will be provided with opportunities to have their ideas incorporated in the study.

In addition, due to the regional nature of the study and the extent of the problem, more formal coordination will be maintained with Federal, State, regional, and local agencies who will provide technical input into the study or play a part in plan implementation. The basic philosophy behind cooperative inter-agency study is to provide a systematic approach for analyzing problems and needs, establish specific sub-objectives from the general Corps established objectives, and develop and evaluate

alternative regional dredged spoil disposal management plan. This team approach is due to the fact that viable resource management plans require interdisciplinary planning to adequately address the broad range of complex issues involved, including the economic, environmental and social consequences of proposed actions. To this end a regional plan formulation committee will be established. The objective of this plan formulation committee is to coordinate the activities of various technical studies and advise on the course of the study. This committee would be composed of decision-making representatives from at least the Corps, DRBC, the environmental departments and Coastal Zone Management Offices of Delaware, Pennsylvania, and New Jersey, EPA, U. S. Fish and Wildlife Service, National Marine Fisheries Service, and the local dredging industry association.

Institutional Studies. A survey of the public institutions in the study area which affect or will be affected by the implementation of a regional dredging disposal plan has been completed. Future efforts will be made to identify additional institutions and the relationships and interrelationships that all of the institutions have in regards to the implementation of specific plans. In addition, coordination with property owners and local sponsors in regards to extension of leases and the obtaining of potential disposal areas will be required.

Social Studies. Involvement to date has included a gathering and review of existing data and a description of the study area and its social composition. Future studies will include an evaluation of the effects

that alternative plans will have locally as well as the effects on the region. This will include a determination of the impacts on local and regional commerce.

Cultural Resource Studies. A sensitivity analysis of historical and archaeological sites in the study area was accomplished in Stage 1. Future efforts will have to be more specific to the alternate plans and will involve the concerned institutions. These efforts will include more detailed mapping and impact analysis on specific areas.

Environmental Studies. Stage 1 efforts included data collection and review, and an overview inventory of various environmental features in in the study area and a discussion of the potential impacts on them due to dredging disposal activities. Also, a "Bibliography and Data Management System" was developed to enable quick retrieval of sources of information.

Work in Stage 2 will involve review of available data as well as the collection of other environmental data as necessary. This will include mapping of various features and a more detailed impact analysis at specific sites. The need also exists for substantial basic data research on existing disposal areas in order to satisfy Section 404 and State permit requirements.

Stage 3 efforts will involve some impact assessment in addition to the preparation of an environmental impact statement and Section 404 Report.

Fish and Wildlife Studies. Coordination with the Fish and Wildlife Service has taken place throughout the development of this report and

will continue through Stages 2 and 3. Efforts will consist of the development of mapping concerning the location of various fish and wildlife resources and the determination of the impact on these resources by alternative plans. In addition, the Fish and Wildlife Service will report on the selected plans.

Economic Studies. Future efforts will include the development of benefits and costs for each regional plan considered. Also, base studies pertinent to the economic assessment of alternative plans to be considered will be necessary. An economic analysis will also be needed to make a more exact determination of the years in which existing and proposed disposal areas would reach zero capacity for disposal.

Surveying and Mapping. Work efforts to date have included general data collection and the preparation of preliminary base maps for the study area. Future efforts in this area will be done in conjunction with the creation of a data bank for the spatial analysis system. USGS quads will be used in the initial screening process, followed by aerial photography and then aerial topographic mapping. Updated hydrographic soundings will also be needed.

This future survey work may be obtained by contracting the services of the 30th Engineer Battalion (Topo)(Army) out of Fort Belvoir, Virginia.

Hydrology and Hydraulics Investigations. Efforts in Stage 1 were basically just a gathering of general data. Work required for Stage 2 will include updating tide frequency levels and flood outline maps, as

well as a review of previous model studies on shoaling reductions. In addition, groundwater aquifer mapping and the determination of recharge areas will be needed as formulation is refined. This will be done in conjunction with the foundations and materials investivations to evaluate the geology.

Foundations and Materials Investigations. Study efforts will include preliminary subsurface explorations in numerous areas, evaluation of geology in conjunction with groundwater monitoring, and the provision of preliminary seepage prevention plans. The investigation of surface drainage improvements will also be needed.

Design and Cost Estimates. Preliminary design and cost estimates of all alternative plans and structures that will result from the screening process will be necessary. In addition, this task covers all the drafting work that will be required.

Real Estate Studies. These include determination of land costs, easements, rights-of-way, and possible damages due to the various alternative plans. Efforts under this task will be extensive due to the nature of the study and its potential involvement with non-Federal owners in numerous locations.

Study Management. The Planning Branch of the Philadelphia District has had the overall management responsibilities to date and this will continue in Stages 2 and 3. That branch will conduct the public involvement program, plan formulation work and coordination activities. Other

elements in the District will be actively involved with the data bank creation of the spatial analysis system, in the monitoring of contracts to be accomplished by architect-engineer firms, and in actual in-house work efforts.

The study management effort will be conducted in accordance with the extensive management guidelines specified in ER 18-2-2 entitled "Intensive Management Milestone System," dated August 1978, and modified by North Atlantic Division through addition of milestones 05A and 09A. The study milestones have been established, and are shown on Table 18 (in the "Funding and Management Schedule" section) and on the study schedule network.

Plan Formulation and Evaluation. Plan formulation efforts in Stage 1 included the creation of an Intra-District Study Committee which includes representatives of the District's Planning, Engineering and Operations elements. The purpose of this committee is to monitor the progress of the study and to advise and give guidance on technically related study activities. These efforts were highlighted by a two day meeting between the District, WES, U. S. Fish and Wildlife Service and others. The results of these meetings were the determination of various alternatives to be examined by this study.

As mentioned in the discussion on public involvement, a regional plan formulation committee will be established to coordinate the activities of various technical studies and advise on the course of the study. Decision-making representatives from at least the Corps, DRBC, the

AD-A094 799 ARMY ENGINEER DISTRICT PHILADELPHIA PA F/G 13/2
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environmental and CZM offices of Delaware, New Jersey, and Pennsylvania, EPA, U. S. Fish and Wildlife Service, National Marine Fisheries Service, and the local dredging industry association are anticipated to be represented on this committee.

Future efforts will entail plan evaluation and assessment based on results from the suitability modeling. Also cited under this task will be the efforts required in characterizing the non-Federal dredging problem and those that examine various techniques and methods of dredging and dredging disposal.

Report Preparation. Efforts to date, under this task, have resulted in the preparation of this Stage 1 Reconnaissance report. Future work under this task will include assembling, writing, editing, typing, drafting, reviewing, revision, reproducing and distributing the Stage 2 and 3 documents. Many elements of the District and other agencies will play a part in the publication of these documents.

Sediment Quality Studies. The U. S. Geological Survey has already begun to collect and analyze Delaware River bottom sediments from nine locations with Stage 2 funds allocated for FY 1979. Continued work will be required in Stage 2 to evaluate the bottom sediments at other locations, including Wilmington Harbor and the lower Delaware Bay.

Spatial Analysis Data Bank Creation. In Stage 2, the overall suitability of potential sites in the study area to dredge disposal will be analyzed. This will be done by a screening process through the use of a digital

data bank and spatial analysis techniques.

Primarily, the appropriate members of the inter-agency study committee will gather available data in mapped format and make the necessary evaluations and rankings of the various features.

Supervision and Administration. Work under this task has and will continue to involve the supervisors who oversee the study and provide guidance where needed. In addition, overhead and other indirect costs which cannot be allocated directly to other tasks, will be included here.

FUNDING AND MANAGEMENT SCHEDULE

Study Cost Estimate. The study costs were derived from estimates furnished by the pertinent office elements that would be involved. The study costs have been distributed among the accounts and sub-accounts as established in OCE ER 11-2-220 entitled "Civil Works Activities, General Investigations," dated 29 July 1977. A more detailed breakdown of study costs by accounts and sub-accounts is presented on Engineering Form 2204 (PB-6) which is included in Appendix F. Also included in this Appendix is a proposed detailed breakdown (Table F-1) of study costs by Fiscal Year.

The estimated cost of the study is $1,355,000. This cost estimate includes anticipated cost of living increases at 6% per year and a general contingency of 8 percent. This is an increase of $575,000 over the previously approved estimate to cover the addition of the Indian River and Bay region to the study, the costs of spatial analysis

techniques, and the review of study requirements as the result of Stage 1 investigations. The revisions in each sub-account reflect the revised study direction.

The costs indicated are entirely direct Federal costs to the study and include funds to be transferred to the U. S. Fish and Wildlife Service and the U. S. Geological Survey. The study cost estimate reflects the total study effort.

Study Conduct and Scheduling. The study will be conducted in three stages. Work is scheduled for completion in August 1985. Stage 1 will be complete upon approval of the Stage 1 Reconnaissance Report in July 1979. Public meetings will be held to present the findings of Stages 2 and 3 in the second quarter of FY 84 and the third quarter of FY 85 respectively. If the findings of Stage 2 at the time of the checkpoint conference are favorable, work on Stage 3 will begin following the Stage 2 public meeting.

The proposed study milestones are shown in Table 18 and displayed on the study schedule network in Appendix F.

TABLE 18

DELAWARE RIVER DREDGING DISPOSAL STUDY
STUDY MILESTONES

Number	Milestone	Scheduled Date
1	Study Initiation	Feb 78 (completed)
2	POS Approval	Jul 79
3	Stage 2 Report Submittal to NAD	Oct 83
4	Stage 2 Checkpoint Conference	Dec 83
5	Completion of Action MFR	Jan 84
5a	Stage 2 Public Meeting	Mar 84
6	Submit Draft Report & Draft EIS to NAD	Oct 84
7	Stage 3 Checkpoint Conference	Dec 84
8	Completion of Action of MFR	Jan 85
9	Coordination of Draft Report & Draft EIS	Apr 85
9a	Stage 3 Public Meeting	May 85
10	Submission of Final Report & Revised Draft EIS to NAD	Jul 85
11	Release of Division Engineer's Public Notice & Submission of Report to BERH	Aug 85

RECOMMENDATION

It is recommended that the Stage 1 Reconnaissance Report for the Delaware River Dredging Disposal Study be approved.

James G. Ton

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

APPENDIX A

PROBLEM IDENTIFICATION

OVERVIEW OF DREDGING SPOIL DISPOSAL PROBLEM

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LIST OF TABLES

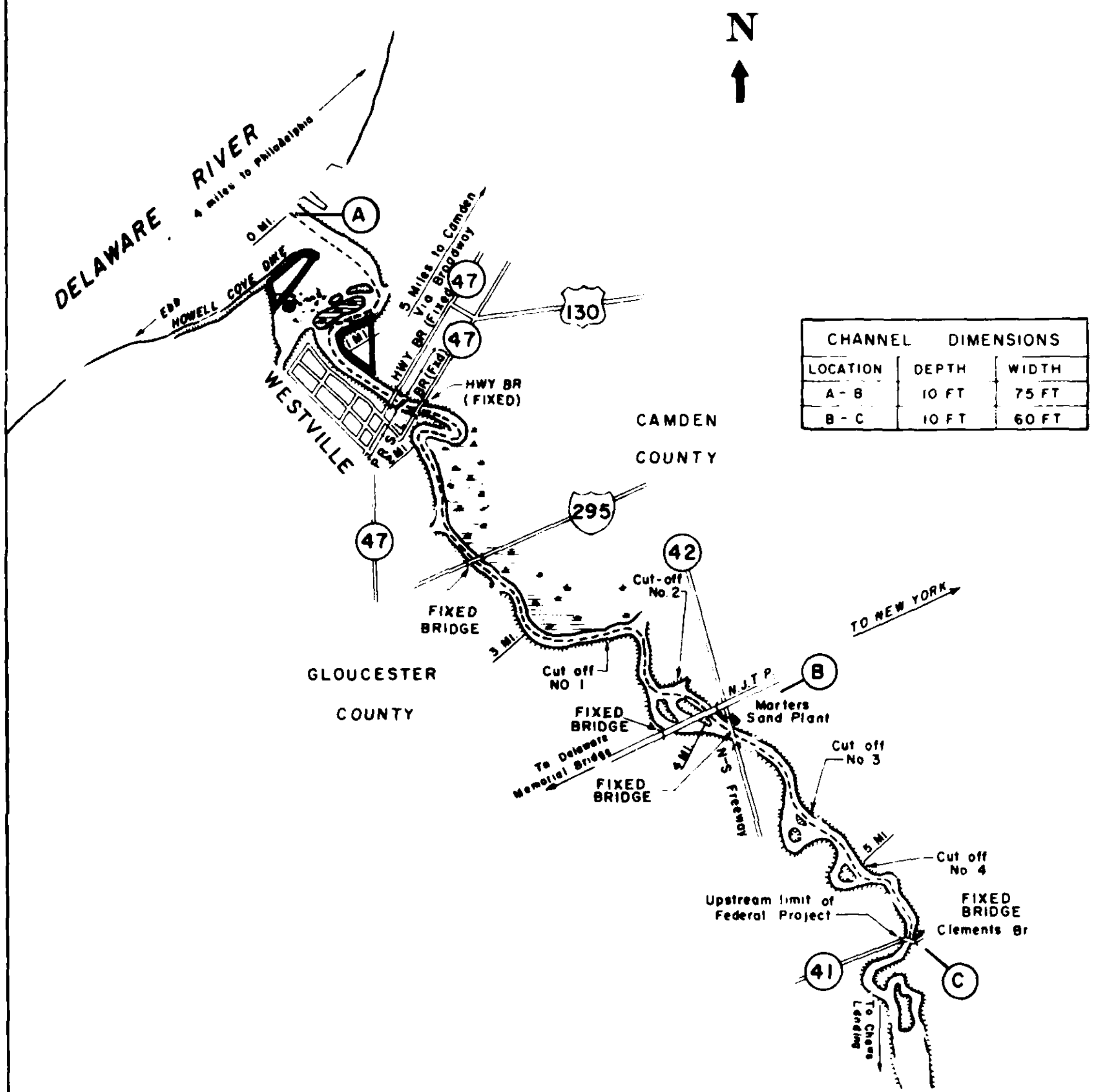
LIST OF FIGURES

There are currently twenty-three active Federal navigation projects in the study area. Section I of this appendix includes brief descriptions of these projects as well as project maps, Figure A-1 to A-24, that locate disposal areas. Tables A-1 to A-4 show quantity removals and Table A-5 and A-6 indicate responsibilities for providing disposal sites. Also included in this section is a brief discussion on the non-Federal dredging problem.

Section II is made up of Table A-7 and A-8 which summarize the status of disposal sites, past and present, while Figures A-25 to A-27 are used to locate them. Sections III and IV discuss the impacts of certain policies on District procedures while Section V includes the resolutions to the study.

BIG TIMBER CREEK, N. J.

PROJECT: The existing project, adopted as HD 70-217 in 1930 and modified by HD 73-15 in 1935, provides for a channel with dimensions and limits as shown from Delaware River to Clements bridge, including 4 cutoffs. Total length of the project is about $5\frac{1}{2}$ miles.



CHANNEL DIMENSIONS		
LOCATION	DEPTH	WIDTH
A - B	10 FT	75 FT
B - C	10 FT	60 FT

Disposal Areas	Used in F.Y.
▭	62

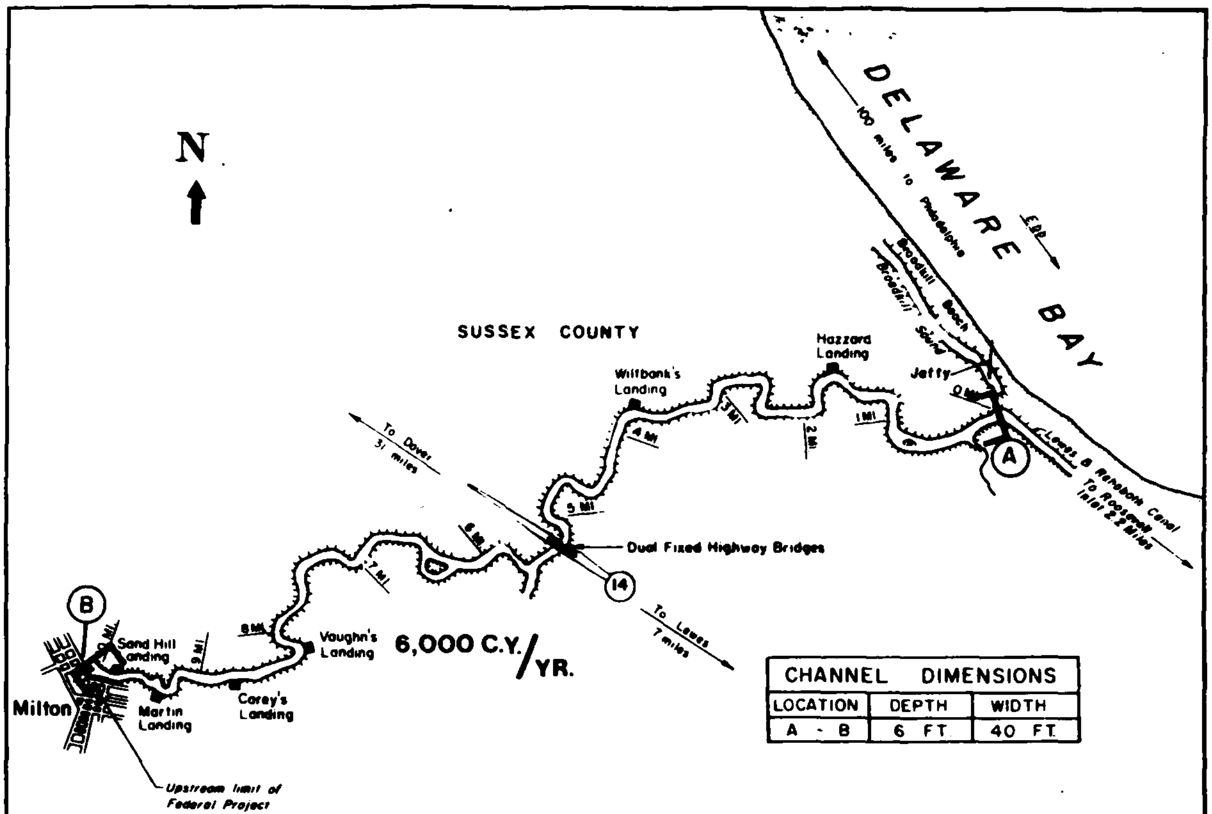
No maintenance dredging has been done from 1963–1978

FIGURE A-1

BIG TIMBER CREEK
NEW JERSEY
FEDERAL PROJECT
LOCATION MAP

BROADKILL RIVER, DELAWARE

PROJECT: The existing project was adopted in 1873 and modified in 1881, by HD 59-214 in 1907, and again by Public Law 83-78 in 1953. It provides for a channel from Delaware Bay to Milton with dimensions and limits as shown. The project length is $10\frac{1}{4}$ miles. The 1953 modification authorized the abandonment of the part of the project which provides for an entrance channel from the Delaware Bay.



CHANNEL DIMENSIONS		
LOCATION	DEPTH	WIDTH
A - B	6 FT	40 FT.

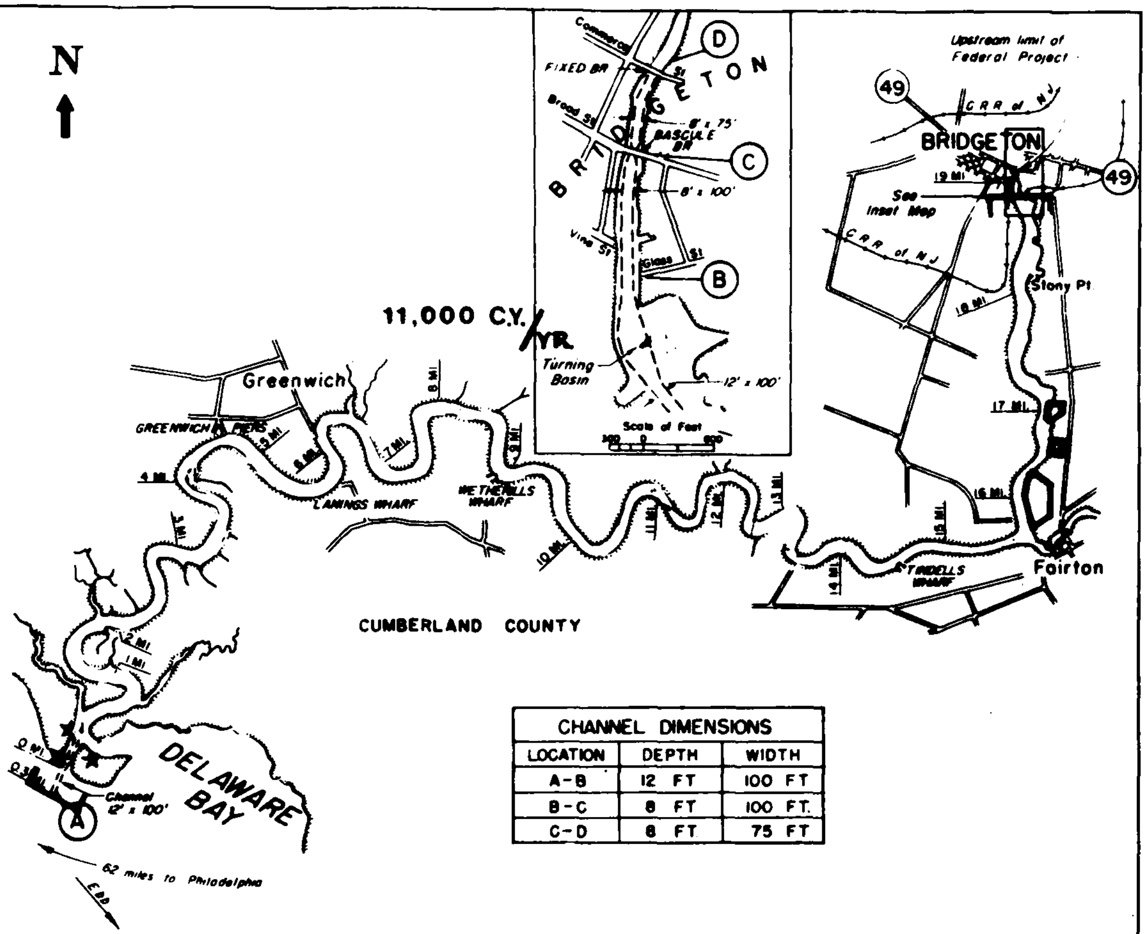
In F.Y. 65 & 66 disposal areas were furnished by contractor.

Average Annual Dredged Quantities from 1963-1978 are given in C.Y./yr.

FIGURE A-2
BROADKILL RIVER
DELAWARE
FEDERAL PROJECT LOCATION MAP

COHANSEY RIVER, N. J.

PROJECT: The original project was adopted in 1873 and modified in 1879. The existing project, adopted as HD 59-645 in 1907 and modified by Senate Committee Print-75 in 1937, provides for a channel with dimensions and limits as shown, including a turning basin 12 feet deep and 250 feet wide located about 300 feet downstream from Glass Street in Bridgeton. The length of the project is about 19½ miles.



CHANNEL DIMENSIONS		
LOCATION	DEPTH	WIDTH
A-B	12 FT	100 FT
B-C	8 FT	100 FT.
C-D	8 FT	75 FT

Disposal Areas	Used in F.Y.
▭	66

Average Annual Dredged Quantities from 1963-1978 are given in C.Y./yr.

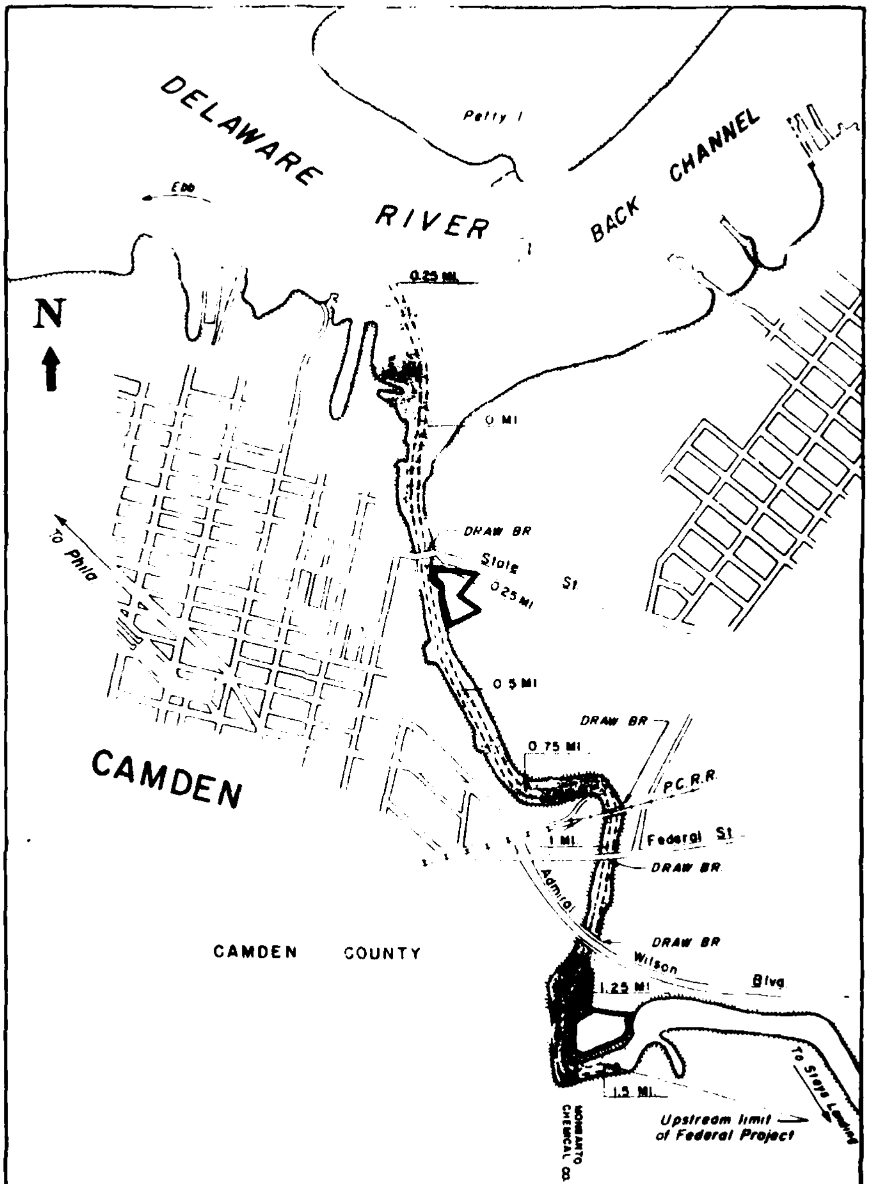
FIGURE A-3

COHANSEY RIVER
NEW JERSEY

FEDERAL PROJECT LOCATION MAP

COOPER RIVER, N. J.

PROJECT: The existing project, adopted as Ex. HD 53-176 in 1896, provides for a channel 12 feet deep and 70 feet wide from Delaware River to the Monsanto Chemical Company plant, formerly Browning Chemical Works. Total length of project is about 1-3/4 miles.



Disposal Areas	Used in FY
▭	62

No maintenance dredging has been done from 1963-1978

FIGURE A-4
COOPER RIVER
NEW JERSEY
FEDERAL PROJECT
LOCATION MAP

DELAWARE RIVER AT CAMDEN, N. J.

PROJECT: The existing project which is a modification to the Delaware River from Philadelphia to the Sea project was adopted as House Document No. 63-1120 in 1919 and modified by House Document No. 70-111 in 1930 and House Document No. 77-353 in 1945. It provides for dredging in front of Camden to a depth of 18 feet from Cooper Point to Berkley Street and 30 feet from the latter point to Newton Creek, with the depth increased to 37 feet in front of the Camden marine terminal. These depths extend from the ship channel in Delaware River to a line parallel with and 50 feet distant from the established pierhead line. The project length is about four miles. The deepening to the 37 foot depth has been deferred for restudy.

DELAWARE RIVER, PHILADELPHIA TO SEA

PROJECT: The existing project adopted as HD 61-733 in 1910, and modified by HD 71-304 in 1930, River and Harbors Committee DOC 73-5 in 1935, SD 75-159 in 1938, HD 76-580 in 1945, HD 77-340 in 1945, HD 83-358 in 1954, and HD 85-185 in 1958. It provides for a channel from deep water in Delaware Bay to a point in the bay near Ship John Light, 40 feet deep and 1,000 feet wide; thence to Philadelphia Naval Base, 40 feet deep and 800 feet wide, with 1,200-foot width at Bulkhead Bar and 1,000-foot width at other bends; thence to Allegheny Avenue, Philadelphia, Pa., 40 feet deep and 500 feet wide through Horseshoe Bend and 40 feet deep and 400 feet wide through Philadelphia Harbor, along west side of channel and 37 feet deep and 600 feet wide along east side of channel; and for improvement of anchorages at Reedy Point, Deepwater Point, Marcus Hook, and Mantua Creek, each 40 feet deep and 2,300 feet wide with respective lengths of 8,000, 5,200, 13,650, and 11,500 feet; at Gloucester 30 feet deep and about 3,500 feet long and 400 feet wide, and at Port Richmond 37 feet deep and about 6,400 feet long and 750 feet wide. Project also provides for construction of dikes and training works for regulation and control of tidal flow; for maintenance of an area on north side of channel opposite Philadelphia Naval Base between Shipway 3 and Schuylkill River to 40 feet deep and a width of 150 feet on Mifflin Range; and for maintenance of any areas dredged by local interests to 35 feet deep between channel and a line 100 feet channelward of pierhead line between Point House wharf and Philadelphia Naval Base, when in opinion of Chief of Engineers such areas are so located as to be of benefit to general navigation. Section included in project is about 96.5 miles long. Eleven additional areas have been designated as special anchorages or anchorage areas but have not been authorized for improvement.

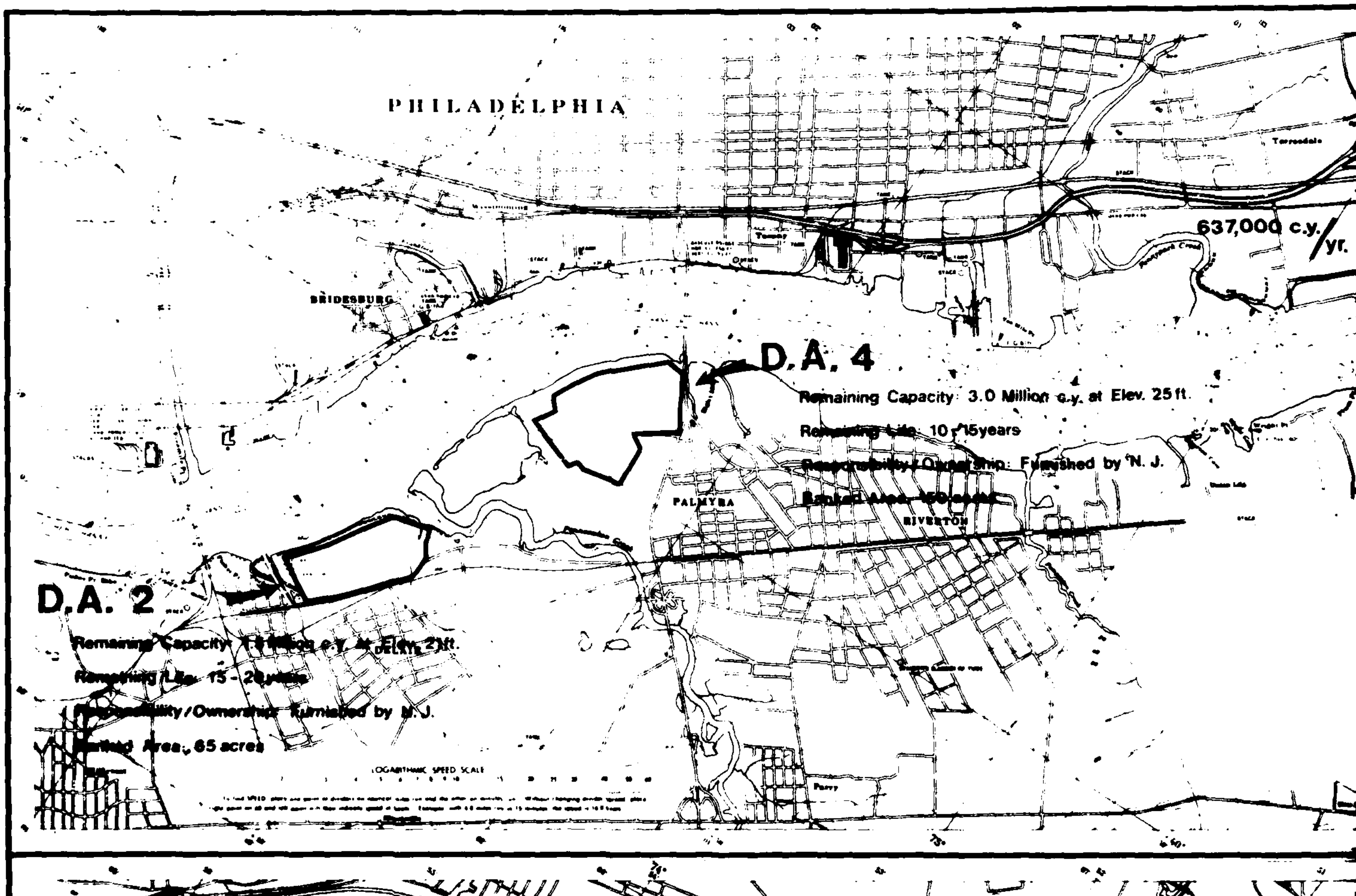
The work remaining to be done is to construct new anchorages at Reedy Point and Deepwater Point, enlarge Mantua Creek anchorage, dredge east side of the channel in Philadelphia Harbor from 35 to 37 feet, and deepen Port Richmond anchorage to 37 feet.

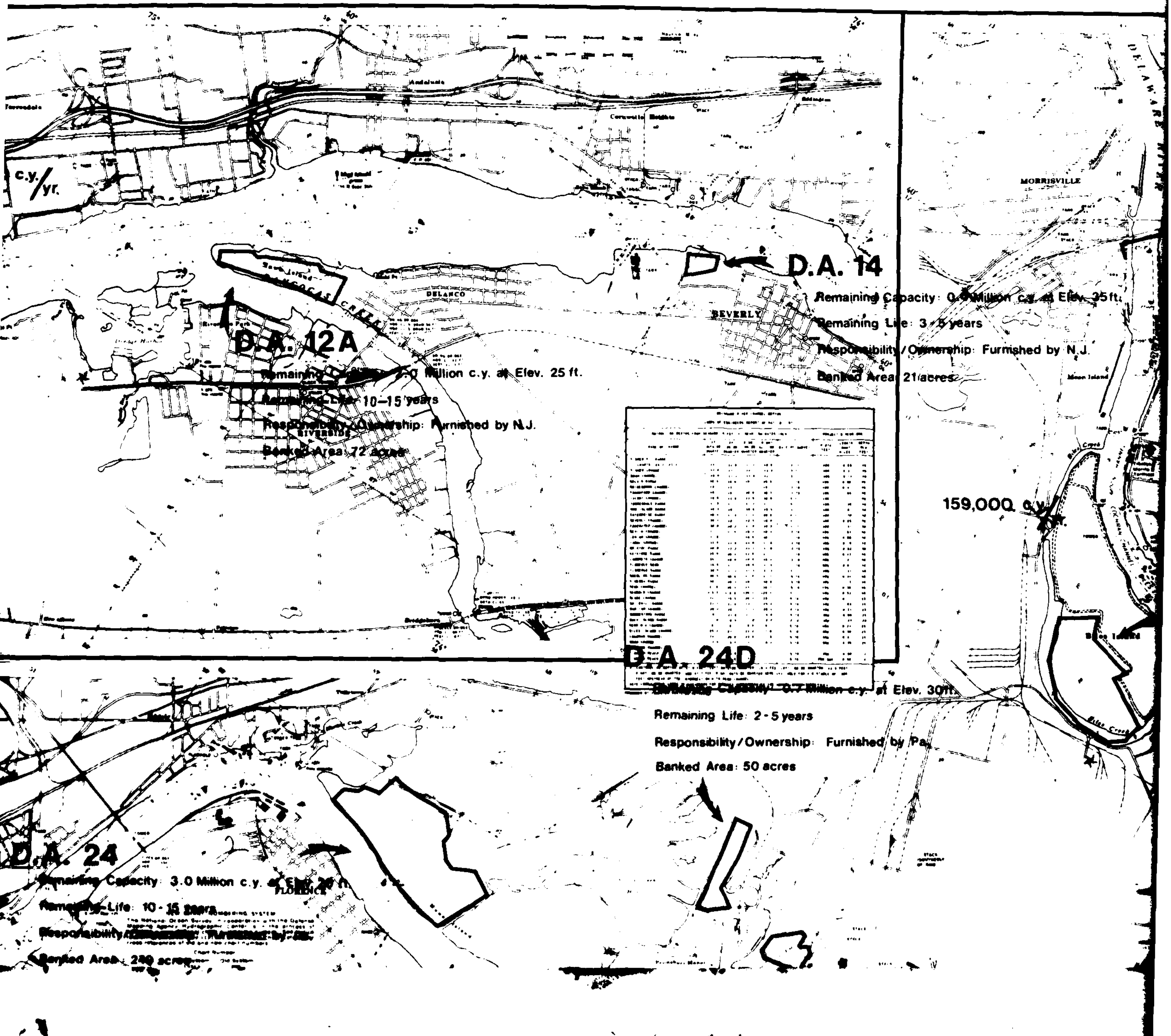
The portion of the authorized channel 37 feet deep and 500 feet wide through Horseshoe Bend and 37 feet deep and 600 feet wide through Philadelphia Harbor along the east side of the channel and Port Richmond anchorage 37 feet deep, except for that portion of the channel which forms a part of the 40 feet deep and 400 feet wide channel portion of the project, was deferred for restudy in 1960.

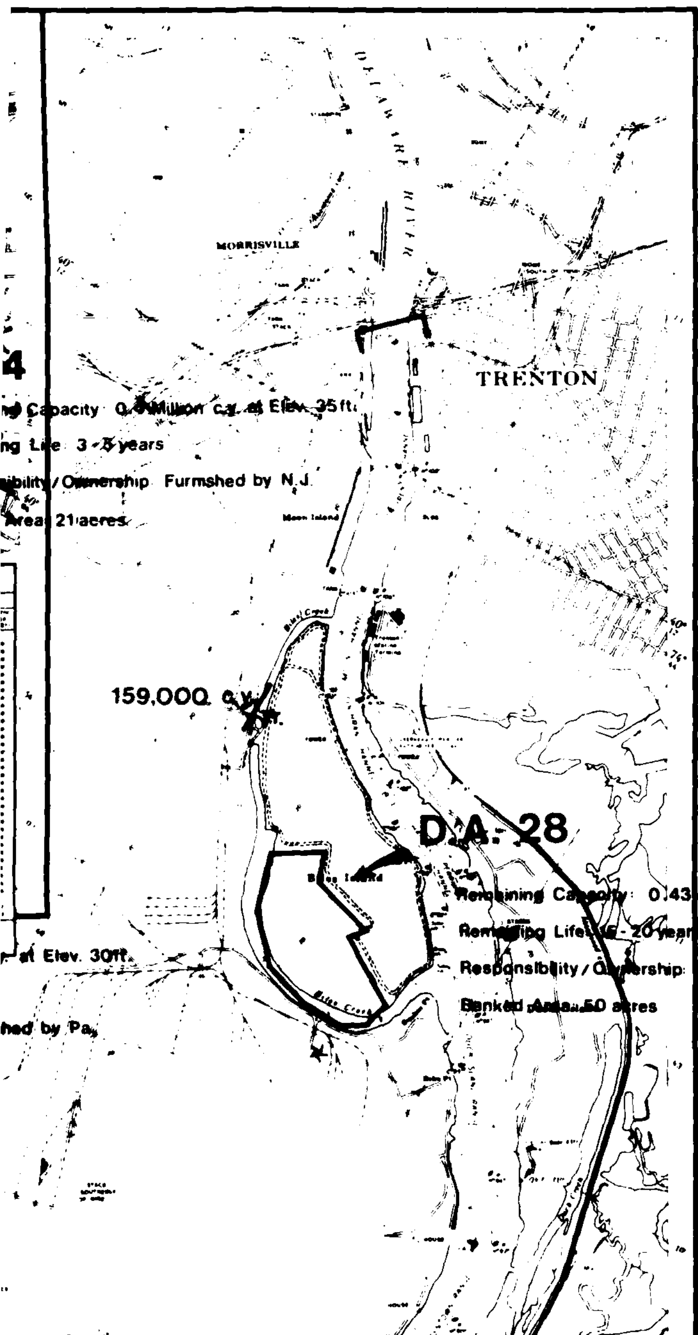
DELAWARE RIVER, PHILADELPHIA TO TRENTON

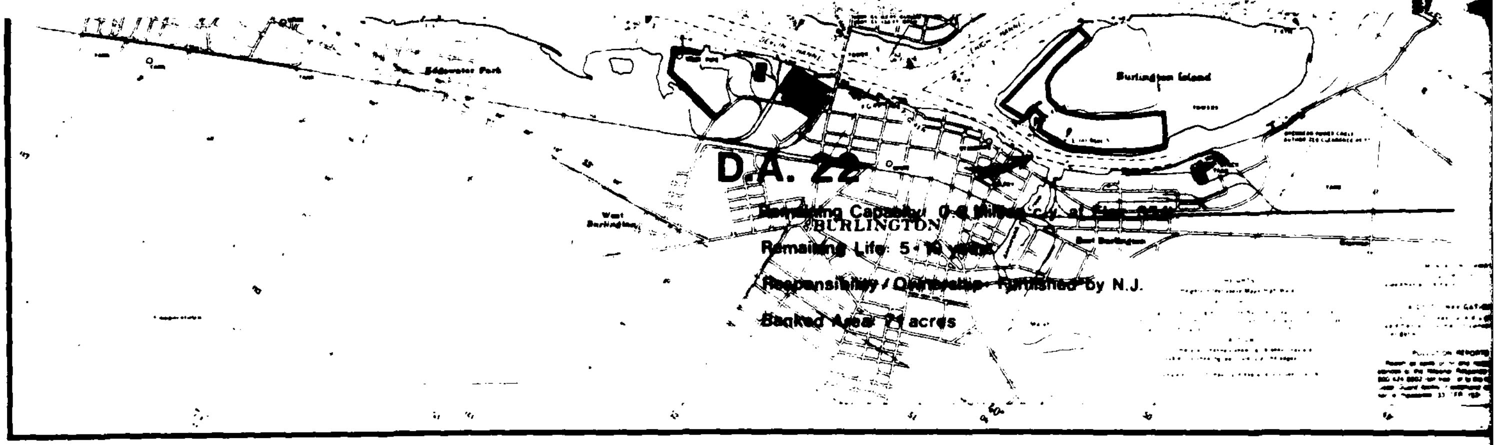
PROJECT: The existing project adopted as House Rivers and Harbors Committee Document 71-3 in 1930, and modified by House Rivers and Harbors Committee Documents 73-11, 74-66, 74-90 in 1935, 1935, 1937, respectively, and House Documents 79-679 in 1946, HD 83-358 in 1954 and SD 95-88 in 1976. It provides for a channel from Allegheny Avenue, Philadelphia, 23.5 miles to upstream end of Newbold Island 40 feet deep and 400 feet wide, with suitable widening of bends, including relocation of channel at Delair Railroad bridge, and reconstruction of bridge, thence 5.5 miles to upper end of Trenton Marine Terminal, 35 feet deep and 300 feet wide, with a turning basin 800 feet wide and 1,700 feet long at the terminal; and maintenance of a channel 12 feet deep and 300 feet wide from upper end of 35-foot channel to Penn Central Railroad Bridge at Trenton, dredged under a previous project. Project also provides for an auxiliary channel 20 feet deep and 200 feet wide east of Burlington Island, extending easterly from main channel to upper end of U. S. Pipe and Foundry Co.'s property at East Burlington, with a turning basin 450 feet wide at upper end; for initial excavation, only, of a cross channel 8 feet deep and 200 feet wide through artificial island opposite Delanco, N.J., and for construction such bank protection works as may be necessary. Section included in project is about 30.5 miles long, excluding auxiliary channel east of Burlington Island, which is 1.4 miles long, and cross channel opposite Delanco. The recent modification provides for widening of the existing channel on the Philadelphia side near the Tioga Marine Terminal to 1,000 feet and depth of 36 feet from Allegheny Avenue upstream for 5,600 feet and construction and maintenance of a 1,300 foot diameter turning basin at a depth of 36 feet.

The work remaining to be done is dredging of the 35 foot deep channel from Newbold Island to Trenton Marine Terminal and widening the turning basin at the terminal as well as the 1976 modification work.


PHILADELPHIA
Torresdale
637,000 c.y./yr.
BRIDESBURG
D.A. 4
Remaining Capacity: 3.0 Million c.y. at Elev. 25 ft.
PALMYRA
RIVERTON
D.A. 2
Remaining Capacity
15 - 20
65 acres
LOGARITHMIC SPEED SCALE
CROYDON
BEVERLY
BRISTOL


c.y./yr.
DELANCO
BEVERLY
RIVERSIDE
MORRISVILLE
FLORENCE
D.A. 14
Remaining Capacity: Million c.y. at Elev. 35ft.
Remaining Life: 3-5 years
Responsibility/Ownership: Furnished by N.J.
Banked Area: 21 acres
D.A. 12A
Million c.y. at Elev. 25 ft.
10–15 years
Furnished by N.J.
72 acres
159,000 c.y.
D.A. 24D
Million c.y. at Elev. 30ft.
Remaining Life: 2-5 years
Responsibility/Ownership: Furnished by Pa.
Banked Area: 50 acres
D.A. 24
Capacity 3.0 Million c.y.
Life: 10-15 years


MORRISVILLE
TRENTON
Capacity
years
Furnished by N.J.
21 acres
Moon Island
159,000 c.y.
D.A. 28
Million c.y. at Elev. 20 ft.
Federally leased from Pa.
at Elev. 30 ft.
hed by Pa.


D.A. 22
BURLINGTON
Burlington Island
Edgewater Park
West Burlington
East Burlington

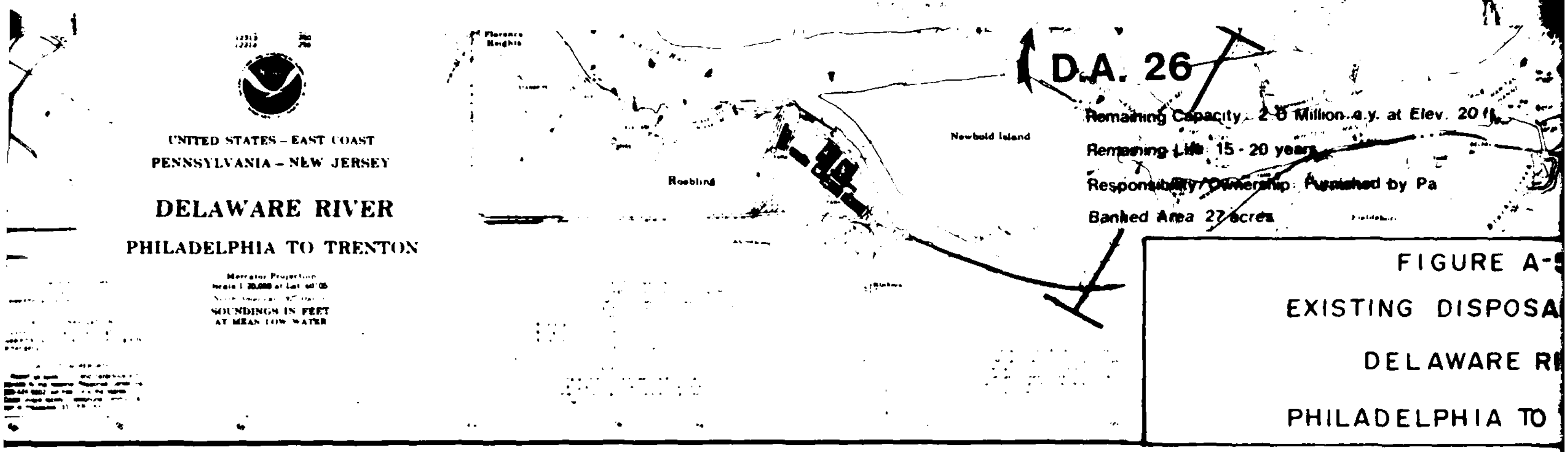


FIGURE A-

EXISTING DISPOSA

DELAWARE RI

PHILADELPHIA TO

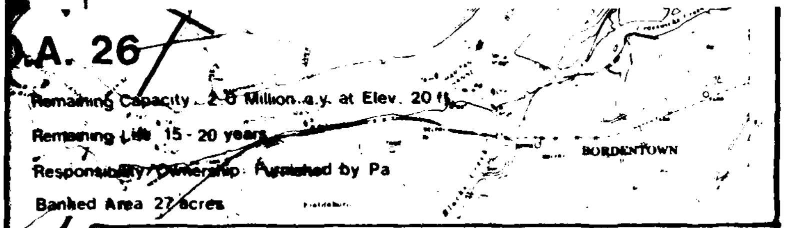
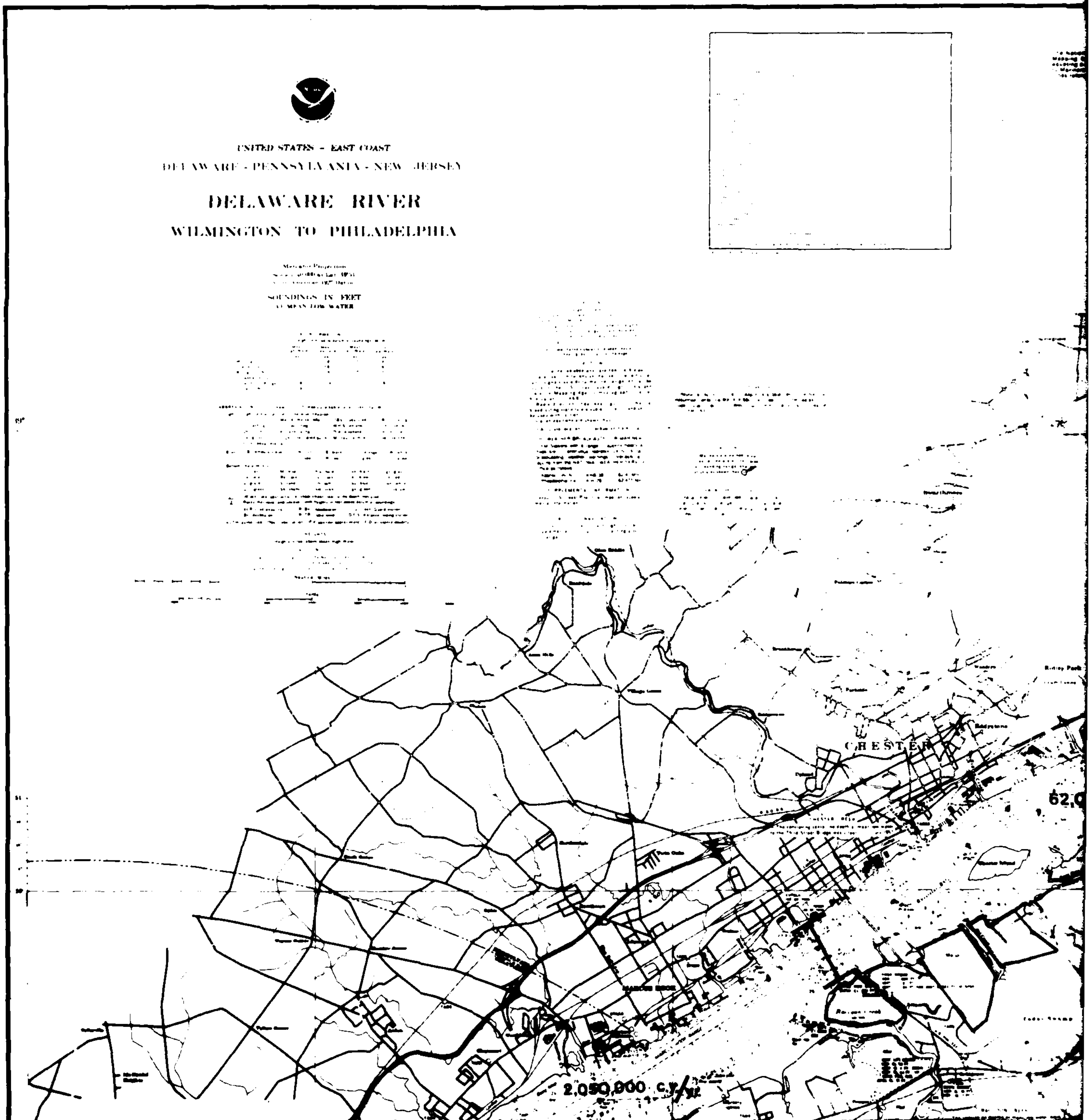


FIGURE A-5

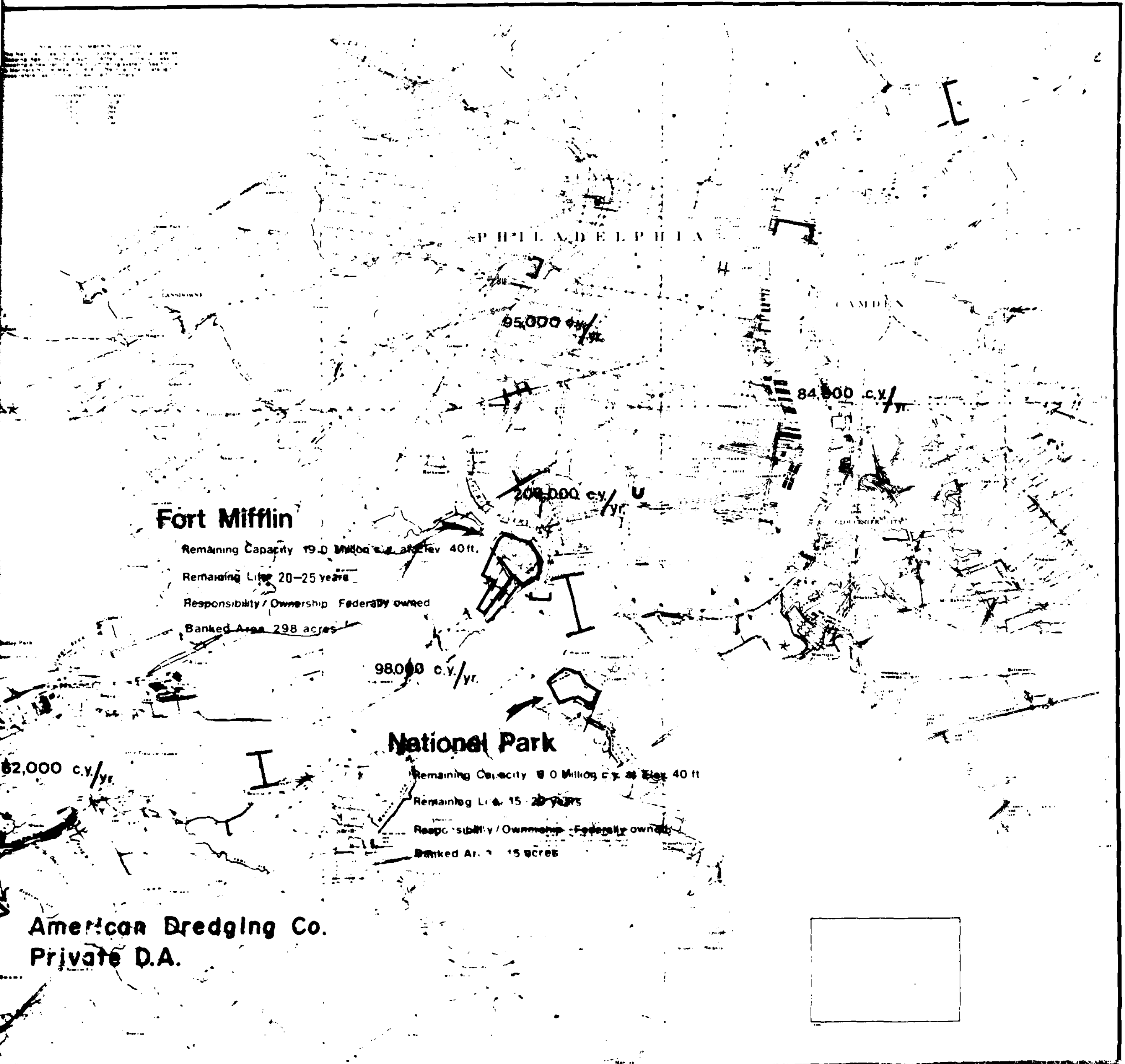
EXISTING DISPOSAL AREAS

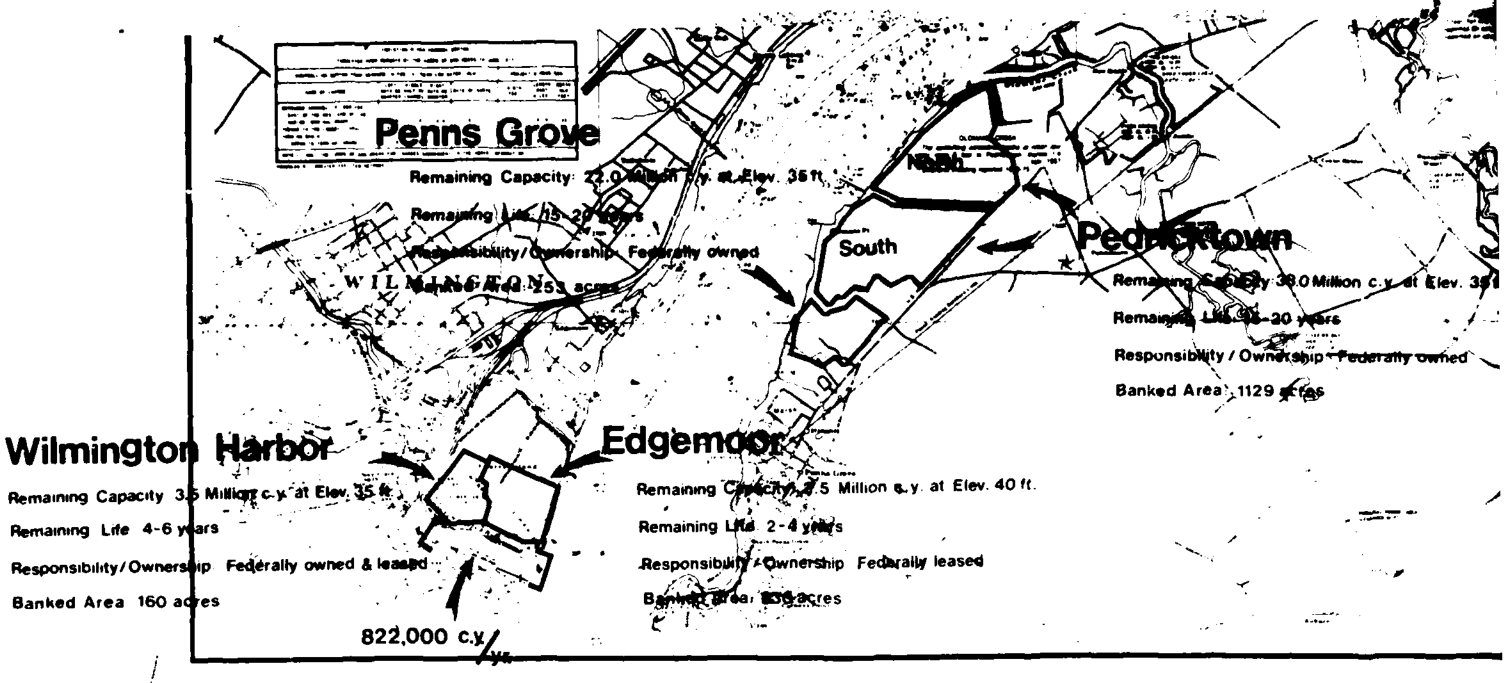
DELAWARE RIVER

PHILADELPHIA TO TRENTON



UNITED STATES - EAST COAST
DELAWARE - PENNSYLVANIA - NEW JERSEY
DELAWARE RIVER
WILMINGTON TO PHILADELPHIA
SOUNDINGS IN FEET
AT MEAN LOW WATER
CHESTER
2,050,000 c.y./yr


PHILADELPHIA
CAMDEN
95,000 c.y./yr.
84,000 c.y./yr.
209,000 c.y./yr.
Fort Mifflin
Remaining Capacity 19.0 Million c.y. at Elev 40 ft.
Remaining Life 20–25 years
Responsibility / Ownership Federally owned
Banked Area 298 acres
98,000 c.y./yr.
National Park
Remaining Capacity 0 Million c.y. at Elev 40 ft
Remaining Life 15 - 20 years
Responsibility / Ownership Federally owned
Banked Area 15 acres
62,000 c.y./yr.
American Dredging Co.
Private D.A.



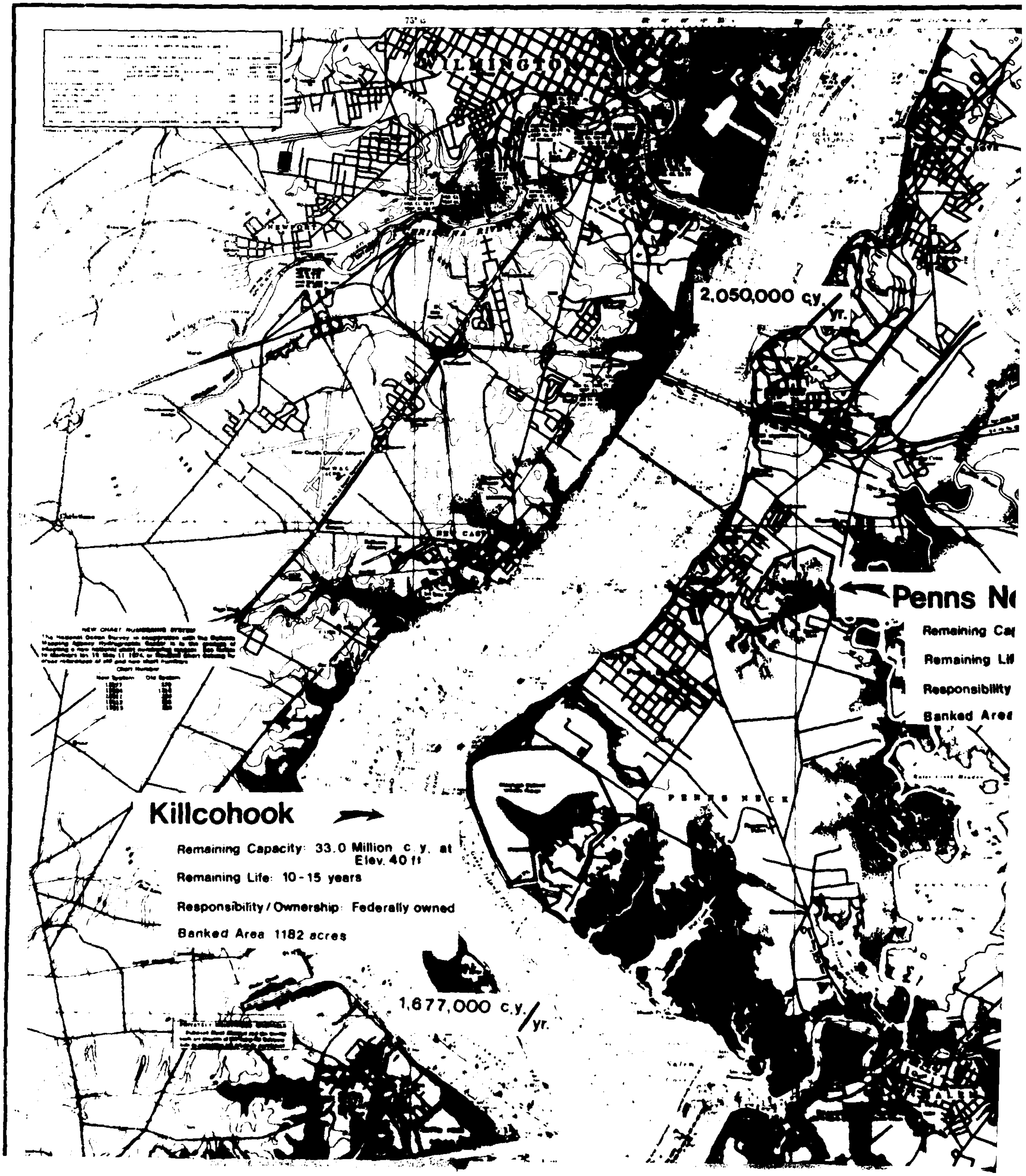
Penns Grove
Remaining Capacity: 22.0
Elev. 35 ft.
Federally owned
WILMINGTON
North
South
Pedricktown
Million c.y.
Elev.
Responsibility / Ownership
Banked Area 1129
Wilmington Harbor
Remaining Capacity
Remaining Life 4-6
Responsibility/Owners
Federally owned & leased
Banked Area 160
822,000 c.y.
Edgemoor
Remaining
Million c.y. at Elev. 40 ft.
Remaining
2-4
Responsibility
Ownership
Federally leased
acres

FIGURE A-6

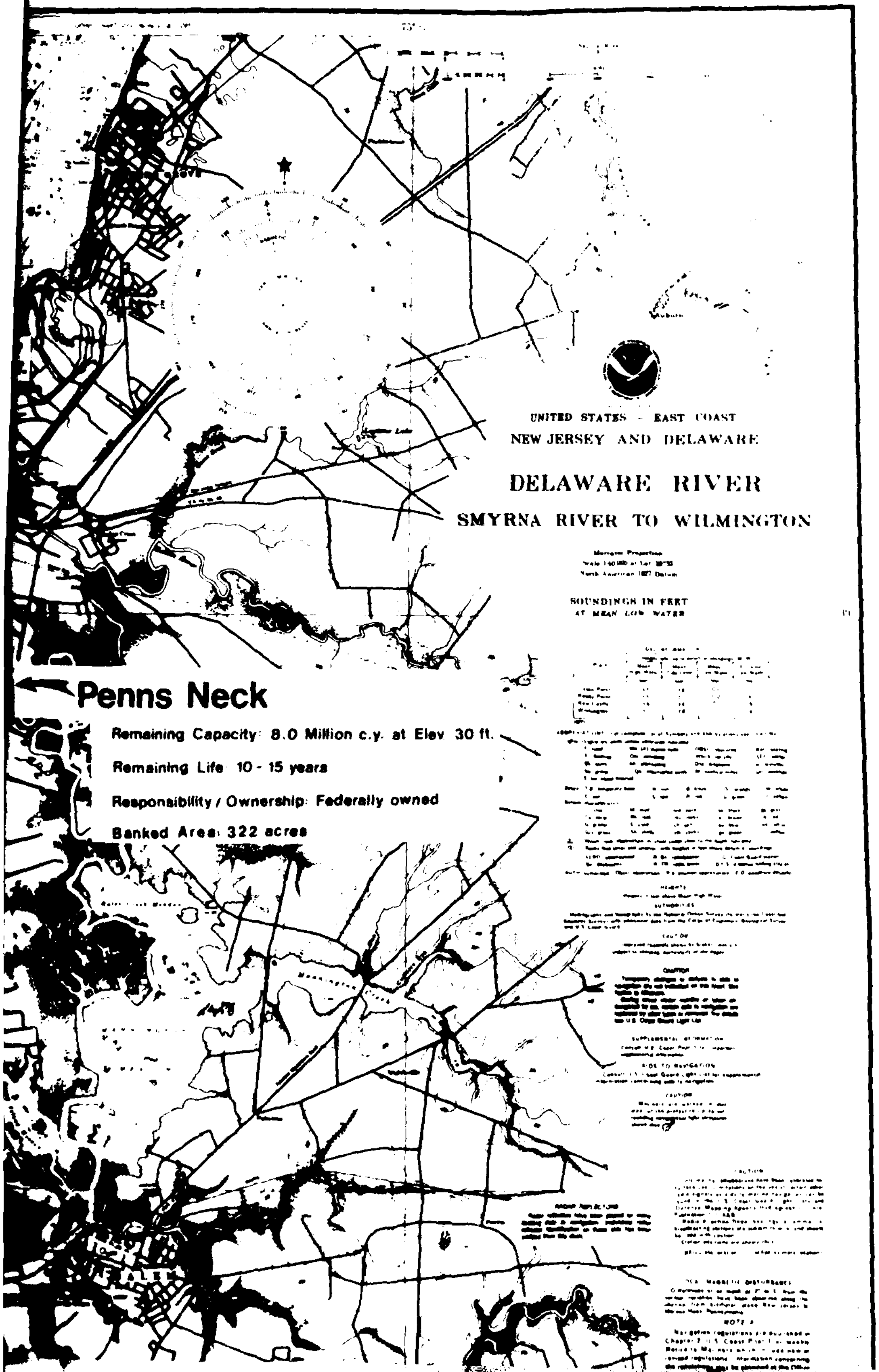
EXISTING DISPOSAL AREAS

DELAWARE RIVER

WILMINGTON TO PHILADELPHIA



WILMINGTON
2,050,000 c.y./yr.
Penns N
Remaining Ca
Remaining Li
Responsibility
Banked Are
PENNS NECK
Killcohook
Remaining Capacity: 33.0 Million c.y. at Elev. 40 ft
Remaining Life: 10-15 years
Responsibility/Ownership: Federally owned
Banked Area 1182 acres
1,677,000 c.y./yr.


UNITED STATES - EAST COAST
NEW JERSEY AND DELAWARE
DELAWARE RIVER
SMYRNA RIVER TO WILMINGTON
SOUNDINGS IN FEET
AT MEAN LOW WATER
Penns Neck
Remaining Capacity: 8.0 Million c.y. at Elev. 30 ft.
Remaining Life: 10 - 15 years
Responsibility / Ownership: Federally owned
Banked Area: 322 acres

2

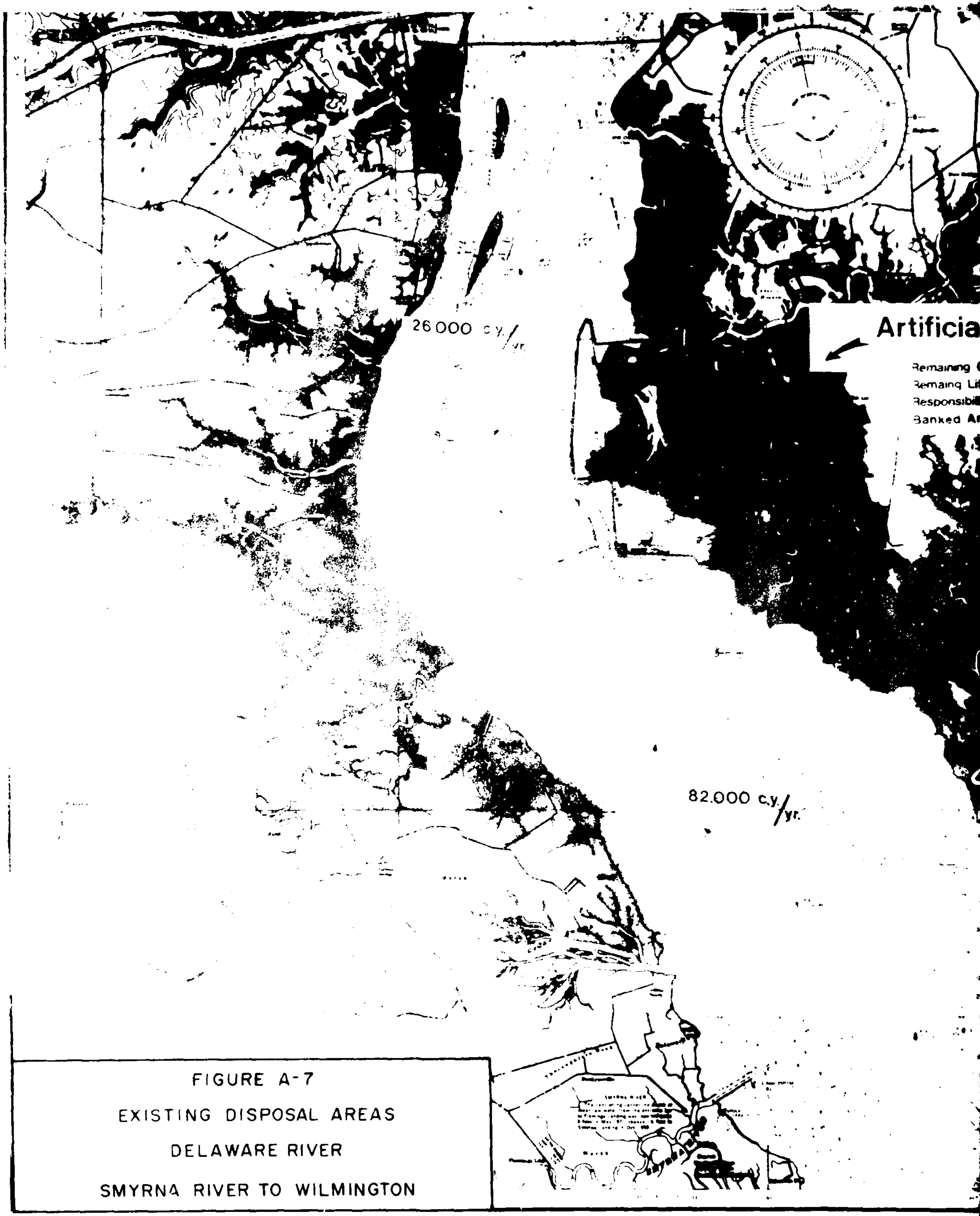
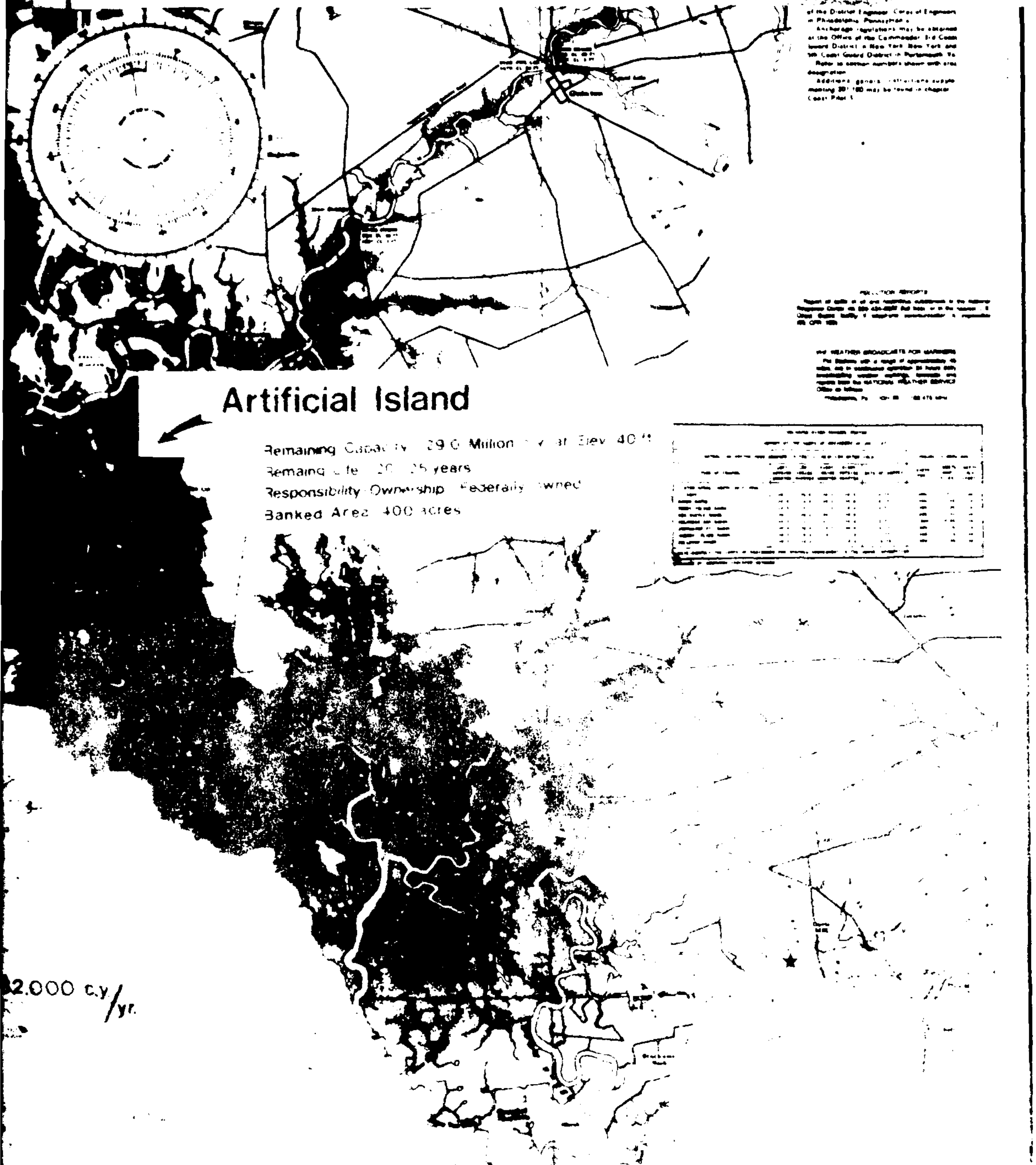
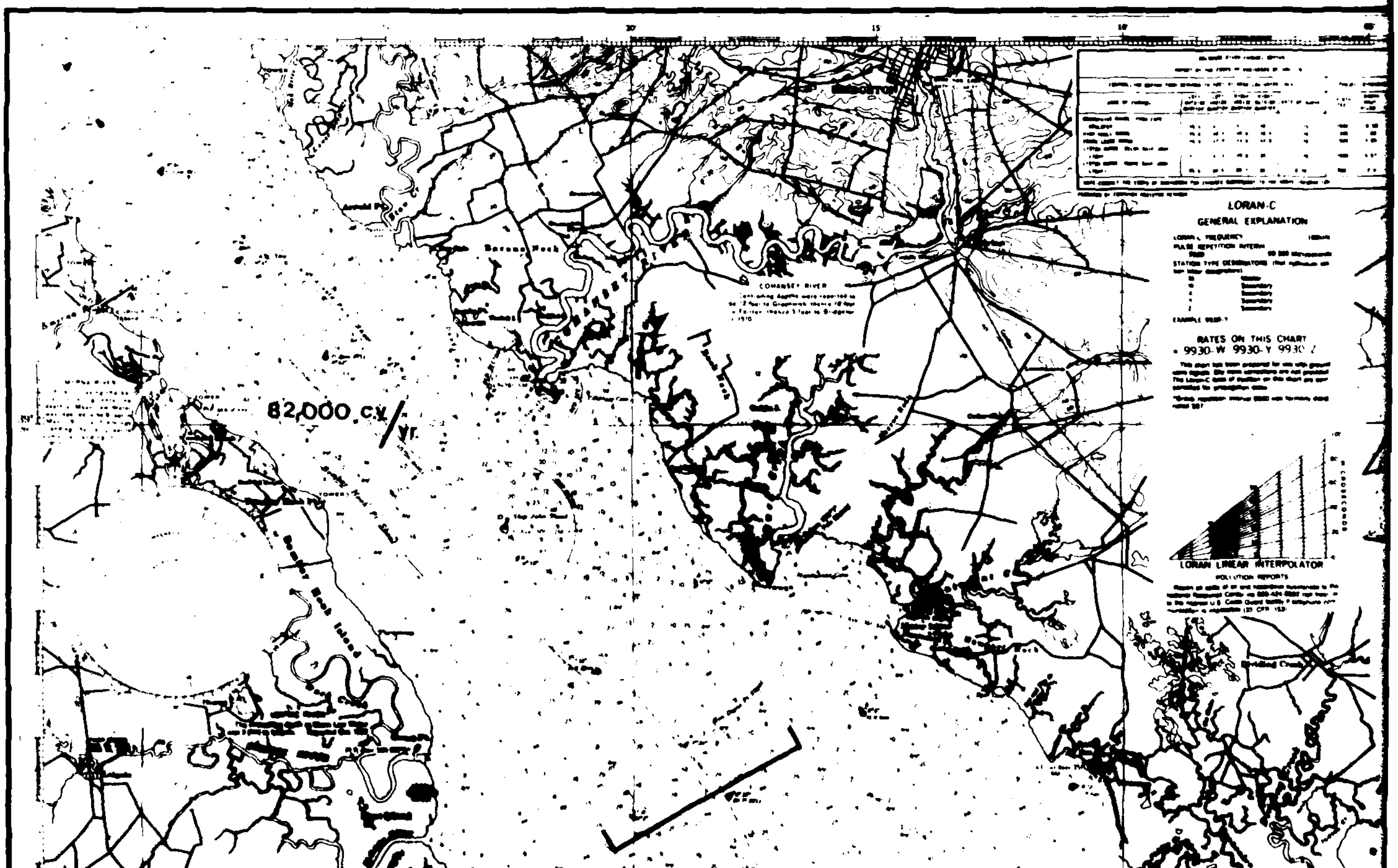
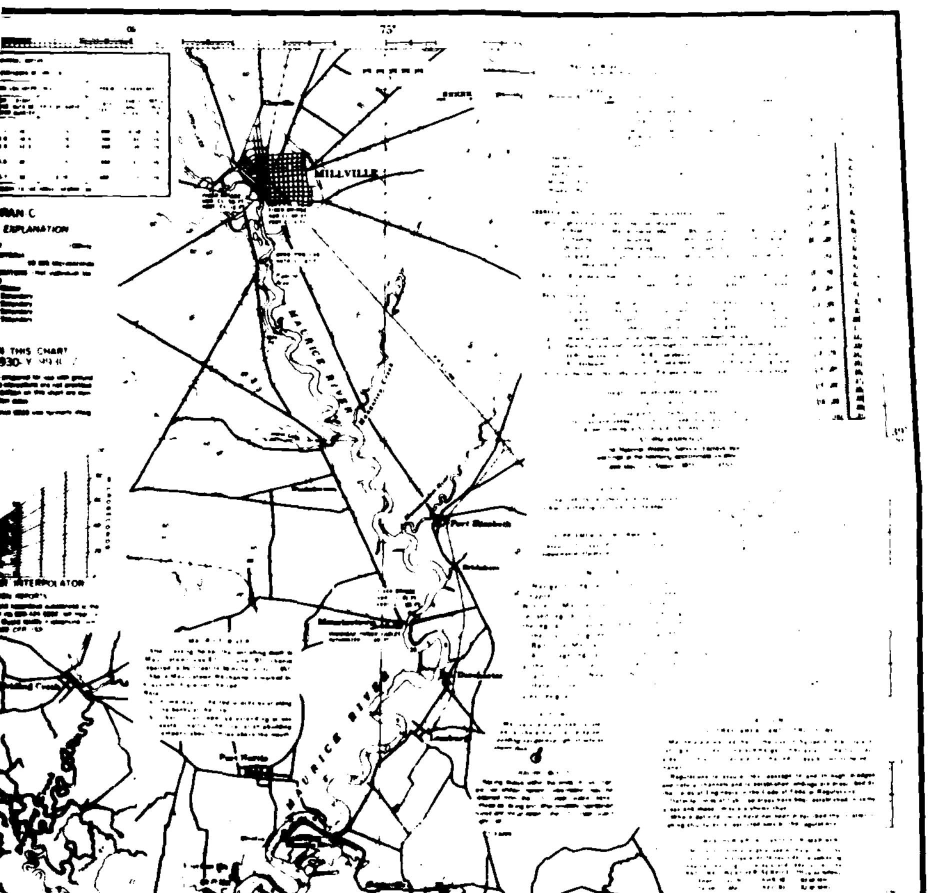


FIGURE A-7
EXISTING DISPOSAL AREAS
DELAWARE RIVER
SMYRNA RIVER TO WILMINGTON



Elevation referenced to Corps of Engineers
Delaware River Datum which is +2.901 M.S.L.


82,000 c.y./yr.
LORAN-C
GENERAL EXPLANATION
RATES ON THIS CHART
COHANSEY RIVER
LORAN LINEAR INTERPOLATOR
POLLUTION REPORTS



75°
MILLVILLE
EXPLANATION
THIS CHART
INTERPOLATOR

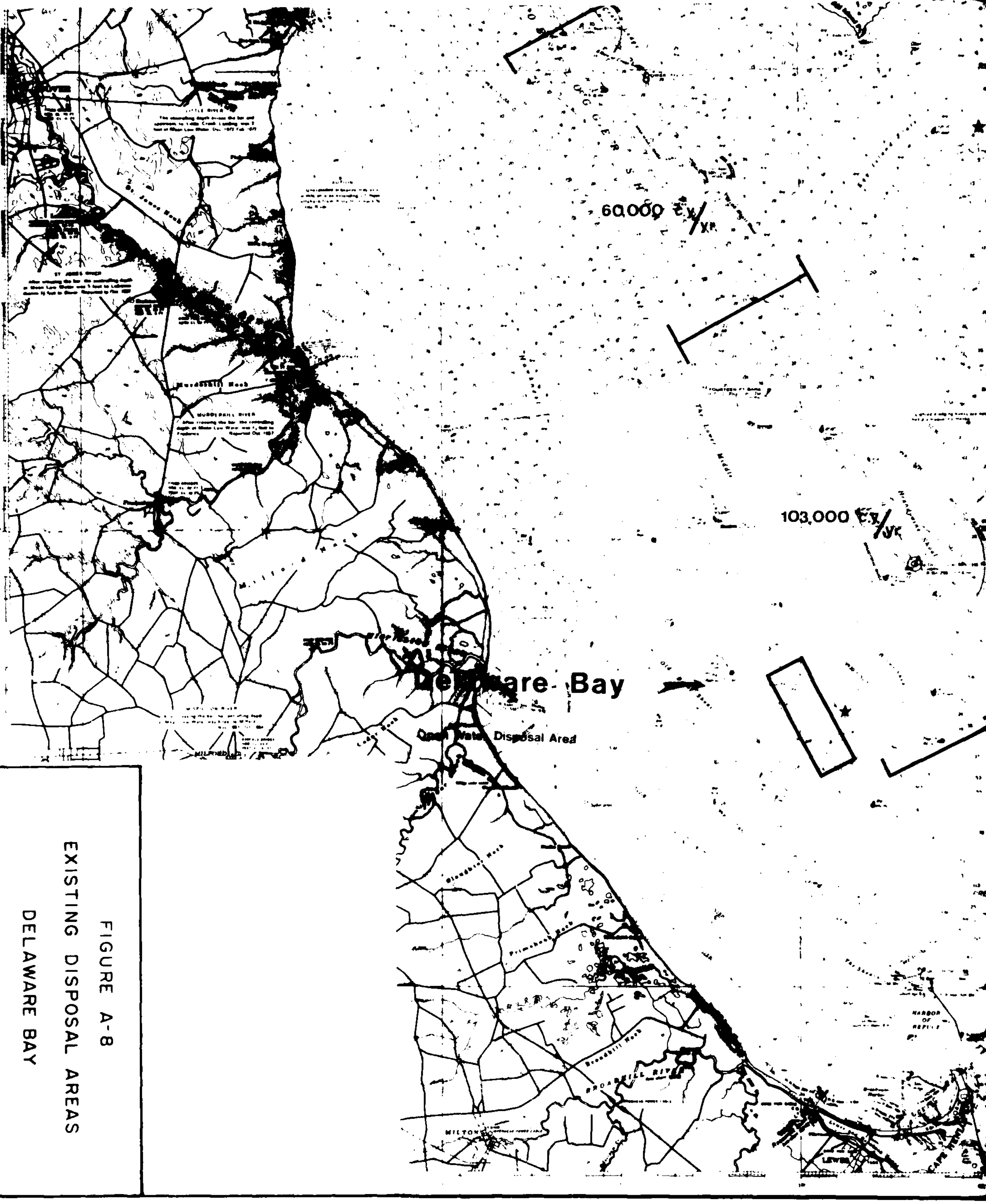
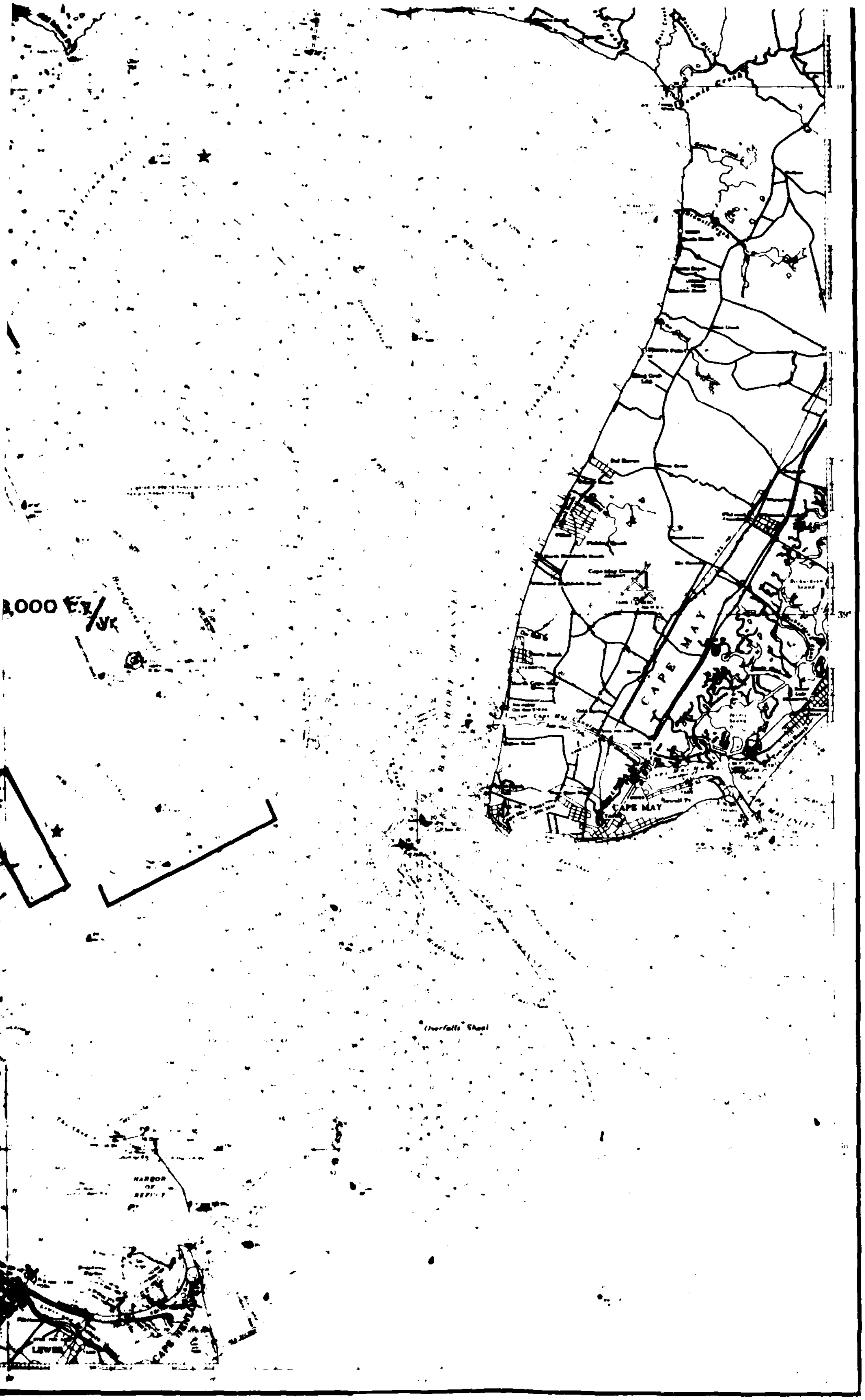


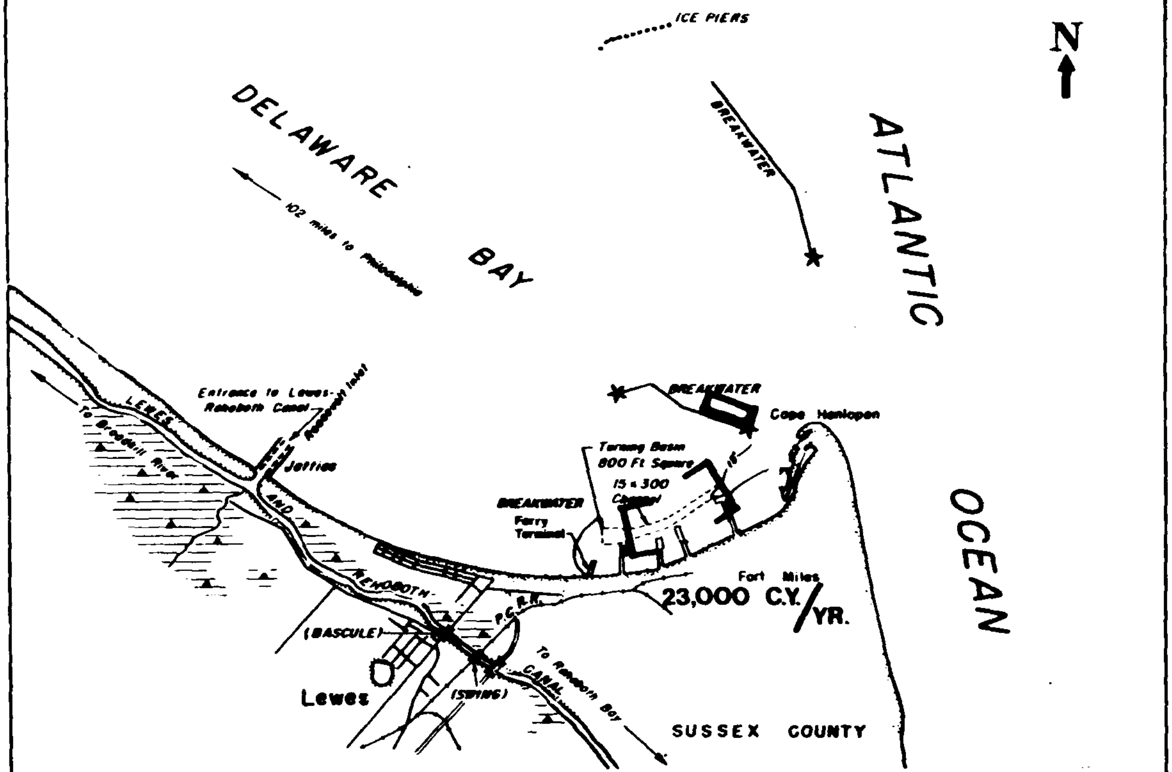
FIGURE A-8
EXISTING DISPOSAL AREAS
DELAWARE BAY



Elevation referenced to Corps of Engineers
Delaware River Datum which is +2 901 M S L

HARBOR OF REFUGE, DELAWARE BAY

PROJECT: The existing project, adopted as HD 52-112 in 1896 and modified by HD 70-15 in 1930 andHD 74-56 in 1935, provides for a breakwater 8,000 feet long; 11 ice piers; and a channel, including a turning basin with dimensions and limits as shown.



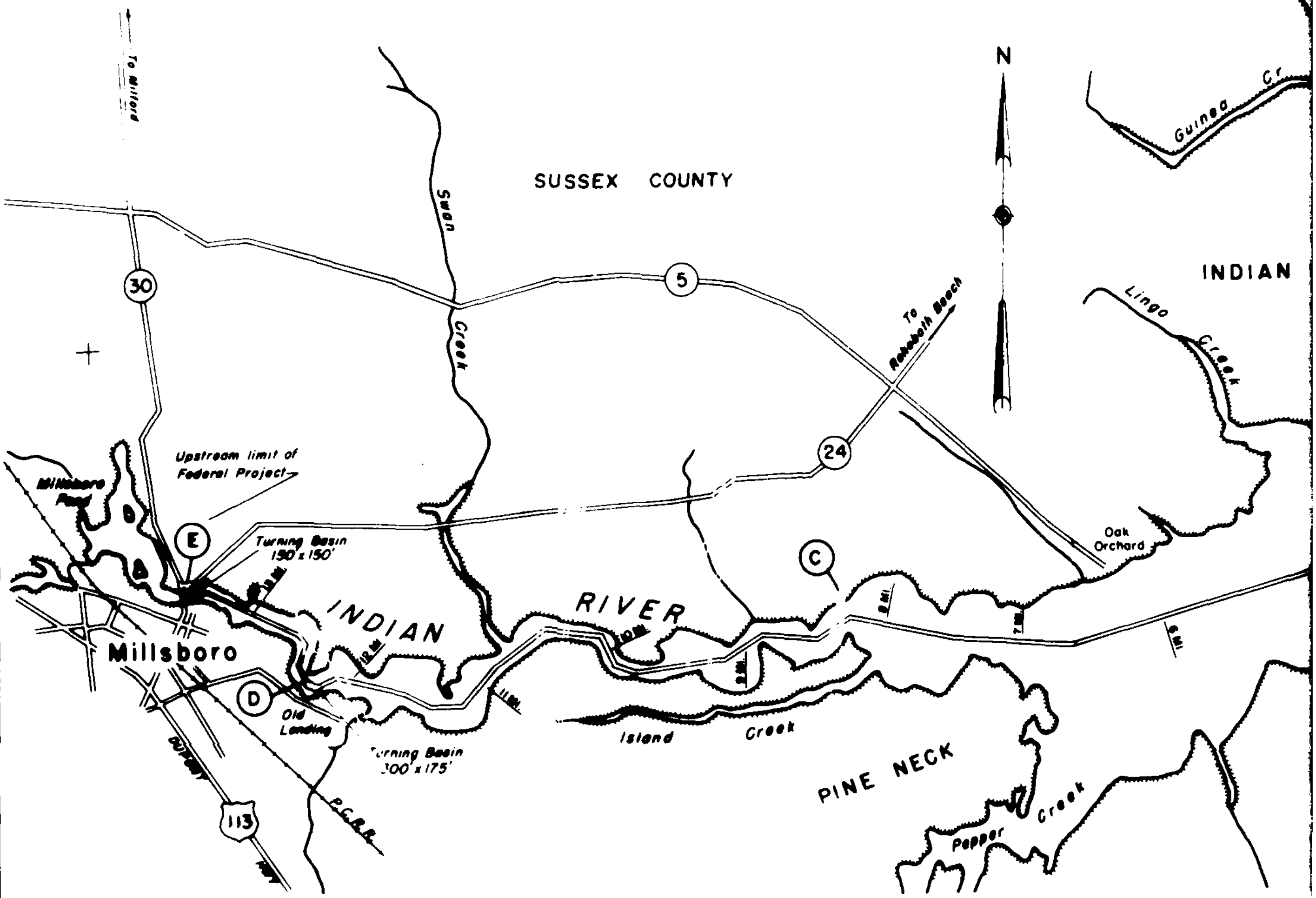
Disposal Areas	Used in F.Y.
▭	63, 64

Average Annual Dredged Quantities from 1963-1978 are given in C.Y./yr.

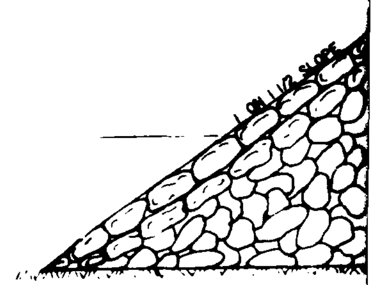
FIGURE A-9
DELAWARE BAY
HARBOR OF REFUGE
FEDERAL PROJECT
LOCATION MAP

INDIAN RIVER INLET AND BAY, DELAWARE

PROJECT: The original project was adopted as Senate Ex. D. 47-176 in 1882. The existing project was adopted as Rivers and Harbors Committee Doc. 75-41 in 1937 and modified by HD 76-330 in 1945. It provides for a channel from Indian River to Millsboro with dimensions and limits as shown; a turning basin 9 feet deep, 175 feet wide and 300 feet long at Old Landing; and jetties at the inlet.



CHANNEL DIMENSIONS		
LOCATION	DEPTH	WIDTH
A – B	15 FT.	200 FT.
B – C	9 FT.	100 FT.
C – D	9 FT.	80 FT.
D – E	4 FT.	60 FT.

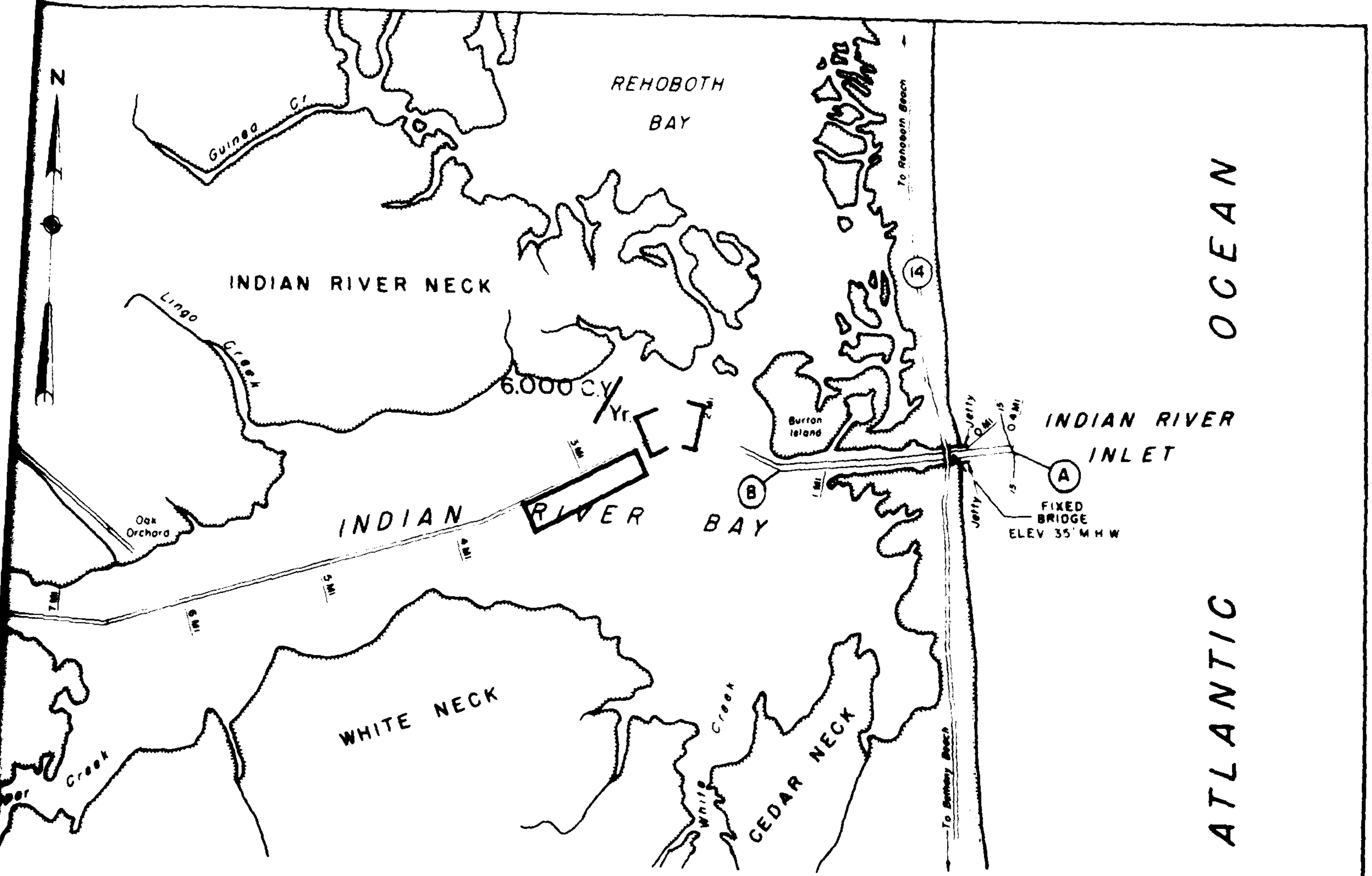


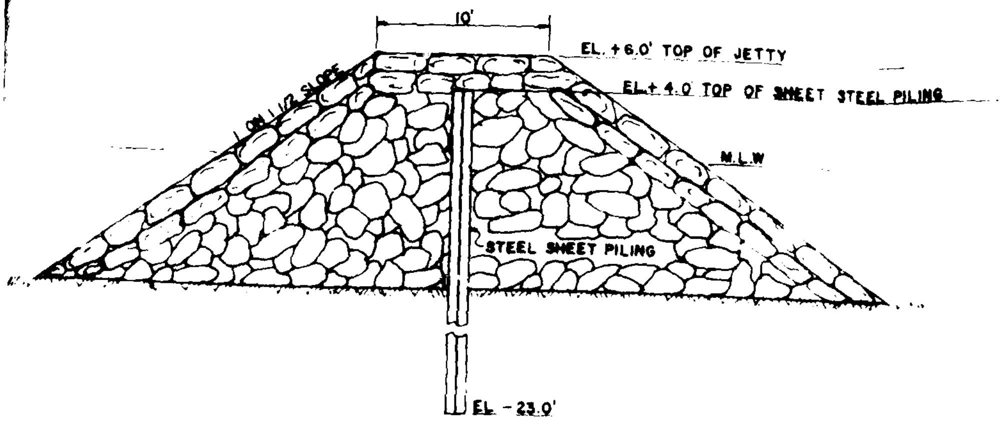
Disposal Areas Used in F.Y.

69, 71

TYPI

Average Annual Dredged Quantities from 1963 - 1978 are given in C.Y./yr.





TYPICAL SECTION OF JETTY

SCALE 1" = 5'

FIGURE A-10

INDIAN RIVER INLET AND BAY

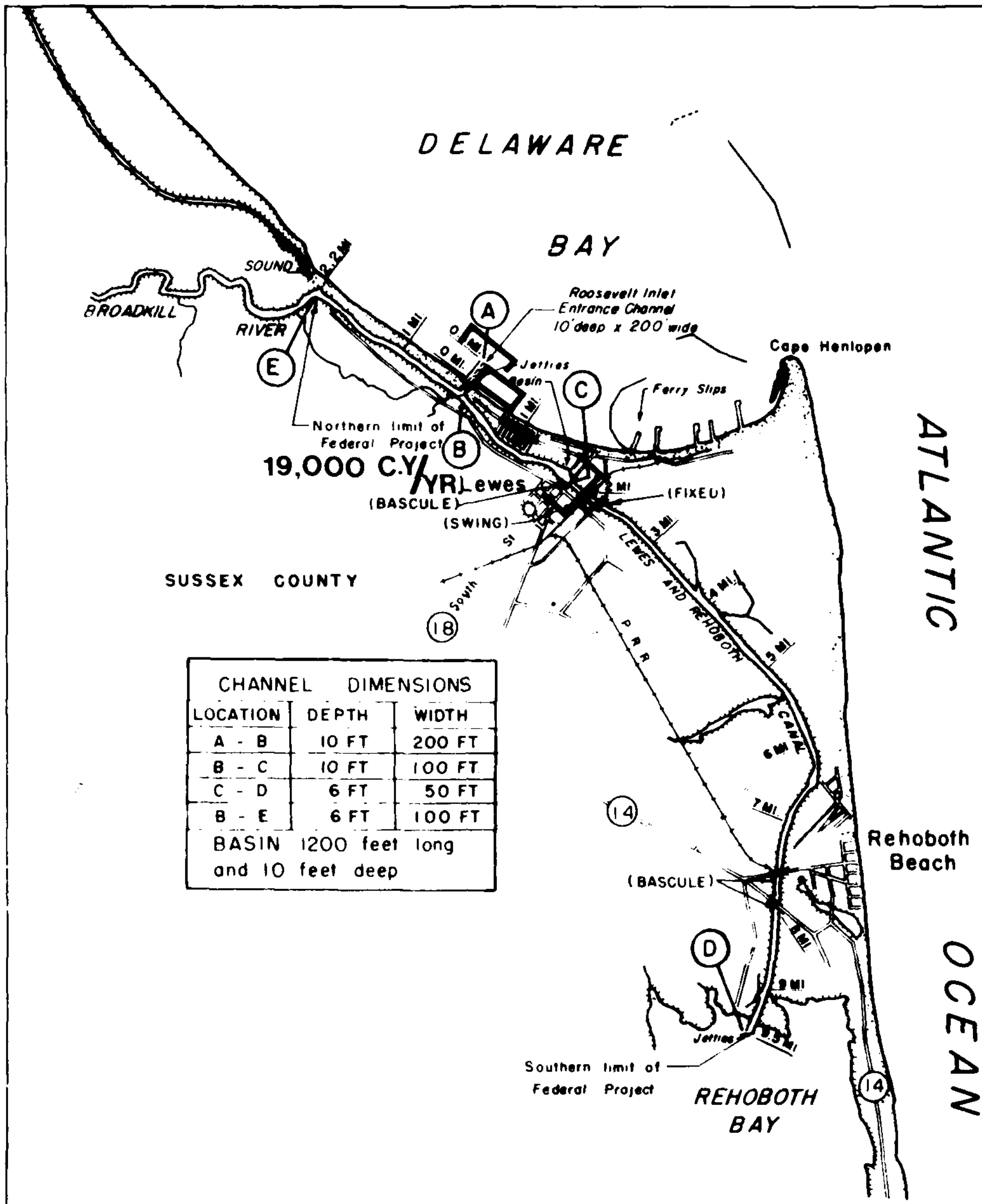
DELAWARE

FEDERAL PROJECT LOCATION MAP

INLAND WATERWAY, REHOBOTH BAY TO DELAWARE BAY, DELAWARE

PROJECT: The existing project, adopted as HD 60-823 and Rivers and Harbors Committee Doc. 61-51 in 1912, was modified by Rivers and Harbors Committee Doc. 74-56 in 1935 and again by HD 77-344 in 1945. It provides for a channel with dimensions and limits as shown (except for locations C - D where to 50 foot wide channel is reduced to 40 feet wide through Deep Cut near Rehoboth); a basin at Lewes; two parallel jetties at the Delaware Bay entrance; and construction of a highway bridge and railroad bridge at Rehoboth. The total length of the project is about 12 miles.

The work remaining to be done, the extension of the existing jetties at the Delaware Bay entrance, is considered to be "inactive"



CHANNEL DIMENSIONS		
LOCATION	DEPTH	WIDTH
A - B	10 FT	200 FT
B - C	10 FT	100 FT
C - D	6 FT	50 FT
B - E	6 FT	100 FT
BASIN 1200 feet long and 10 feet deep		

Disposal Areas	Used in F.Y.
(hatched outline)	65, 70
(plain outline)	64, 70, 75

Average Annual Dredged Quantities from 1963-1978 are given in C.Y./yr.

FIGURE A-11

INLAND WATERWAY

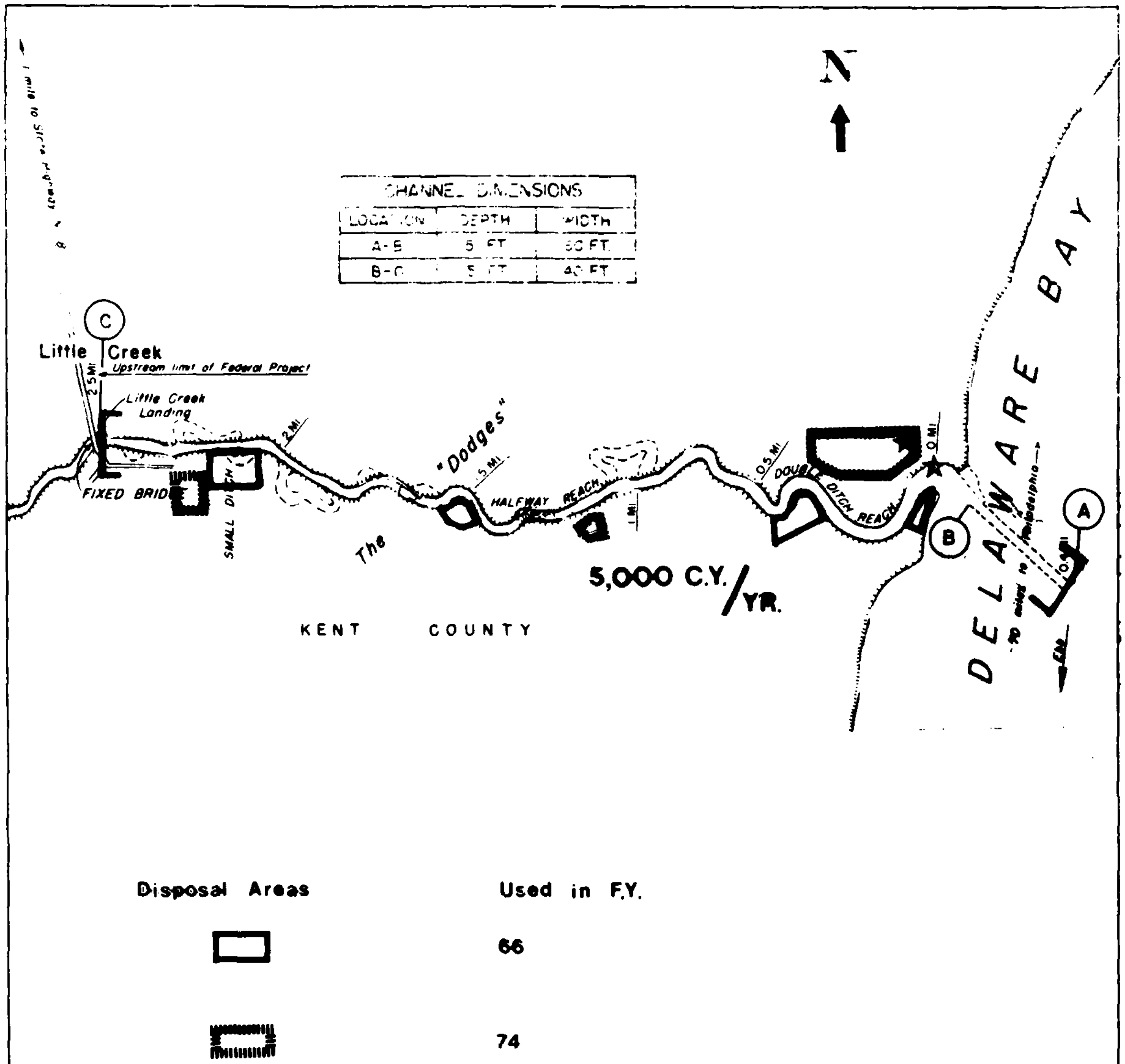
REHOBOTH BAY TO DELAWARE BAY

DELAWARE

FEDERAL PROJECT LOCATION MAP

LITTLE RIVER, DELAWARE

PROJECT: The existing project was adopted as HD 62-626 in 1912. It provides for a channel five feet deep from Delaware Bay to Little Creek Landing. The project length is about three miles.

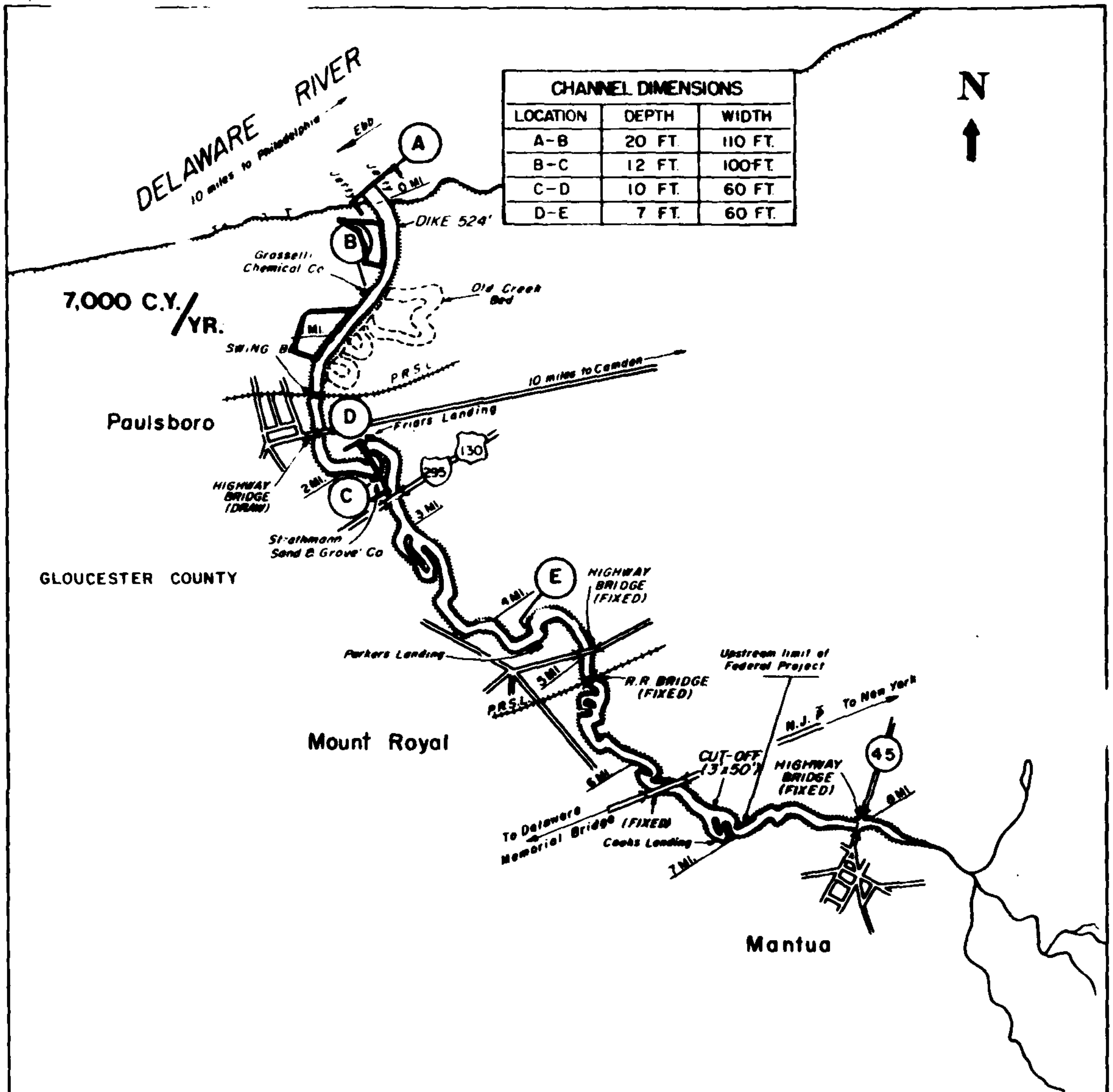


Average Annual Dredged Quantities from 1963 - 1978 are given in C.Y./yr.

FIGURE A-12
LITTLE RIVER
DELAWARE
FEDERAL PROJECT
LOCATION MAP

MANTUA CREEK, N. J.

PROJECT: The original project was adopted in 1889. The existing project was adopted as HD 55-123 in 1899 and modified in 1907, by HD 73-14 in 1935, and HD 75-505 in 1938. It provides for a channel from the Delaware River to one mile below Mantua with dimensions and limits as shown, including a cutoff 3 feet deep and 50 feet wide approximately 9,000 feet above Mount Royal; and the construction of two jetties at the mouth. The project length is about 7 miles.



CHANNEL DIMENSIONS		
LOCATION	DEPTH	WIDTH
A–B	20 FT.	110 FT.
B–C	12 FT.	100 FT.
C–D	10 FT.	60 FT.
D–E	7 FT.	60 FT.

Disposal Areas	Used in F.Y.
▭	63

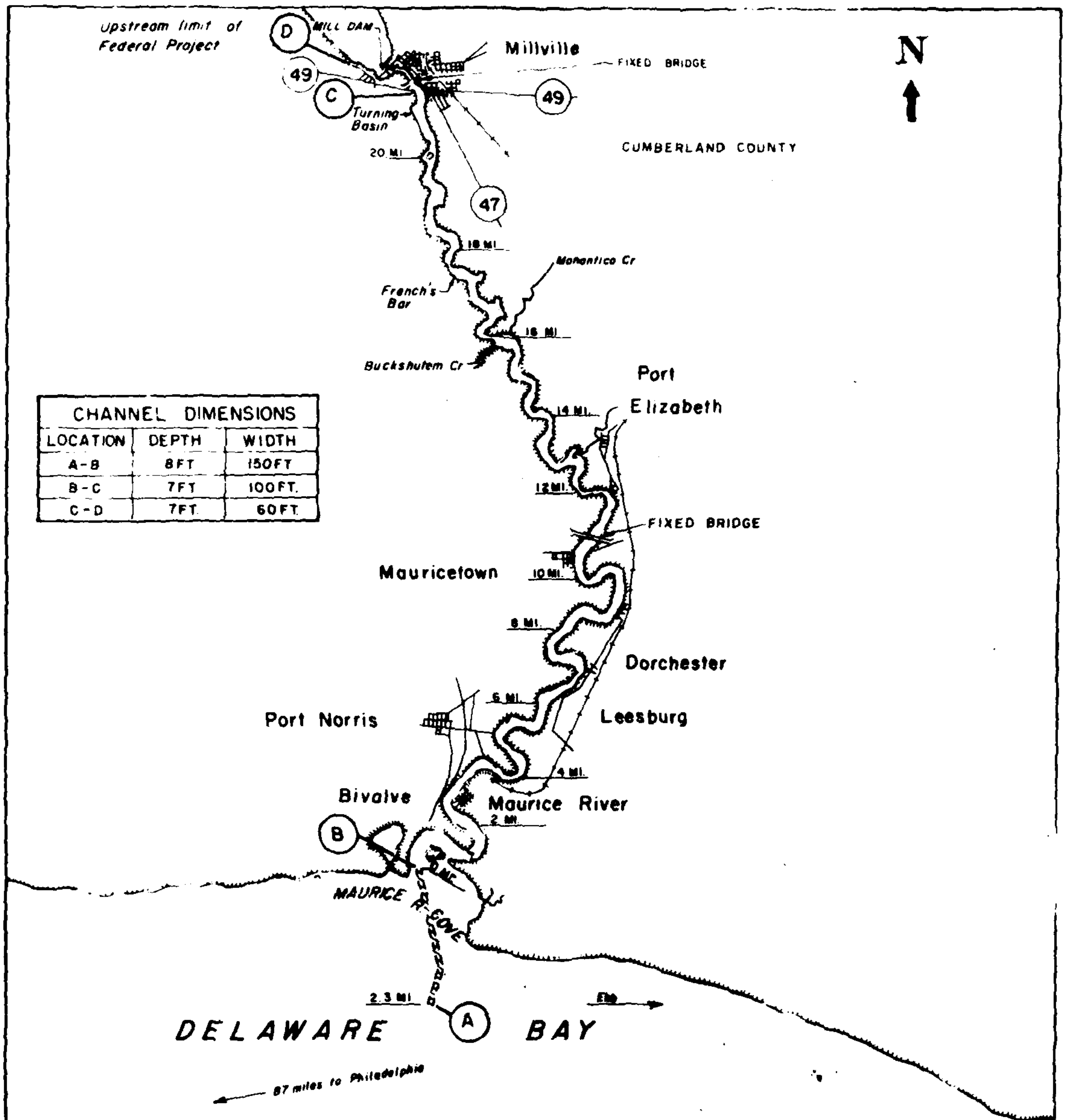
Average Annual Dredged Quantities from 1963 - 1978 are given in C.Y./yr.

FIGURE A-13
MANTUA CREEK
NEW JERSEY
FEDERAL PROJECT
LOCATION MAP

MAURICE RIVER, N. J.

PROJECT: The original project was adopted in 1882 and modified in 1890 and again in 1892. The existing project, adopted as HD 59-644 in 1910 and modified as HD 73-275 in 1935, provides for a channel with dimensions and limits as shown, and for a turning basin 7 feet deep at Millville. The length of the project is about 24 miles.

Work remaining to be done is the deepening of the entrance channel from 7 feet to 8 feet, and the dredging of a channel 7 feet deep, 60 feet wide and 650 feet long in the upper end of the project; this work is inactive.



CHANNEL DIMENSIONS		
LOCATION	DEPTH	WIDTH
A-B	8FT	150FT
B-C	7FT	100FT.
C-D	7FT.	60FT.

No maintenance dredging has been done from 1963-1978

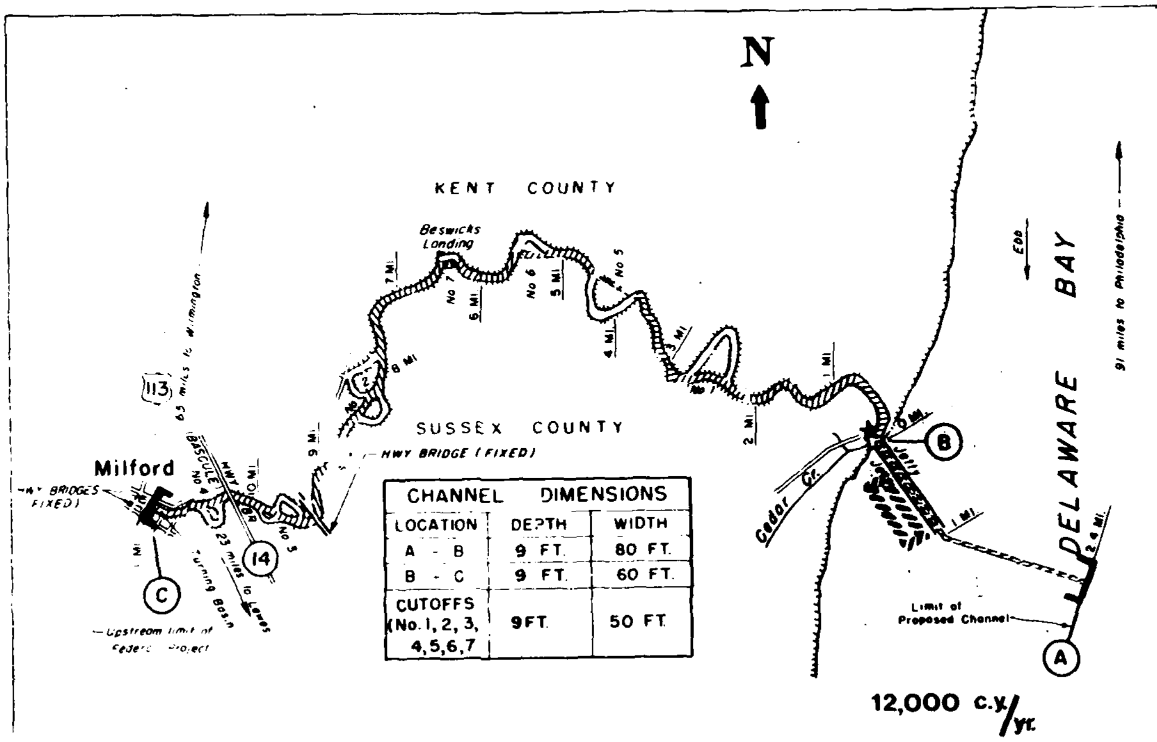
AREAS WHERE NEW WORK REMAINS TO BE DONE, SHOWN THUS

CHANNEL ACROSS MAURICE RIVER COVE HAS BEEN DREDGED TO A DEPTH OF 7 FEET
NO WORK HAS BEEN DONE IN AREA AT UPPER END OF PROJECT

FIGURE A-14
MAURICE RIVER
NEW JERSEY
FEDERAL PROJECT
LOCATION MAP

MISPILLION RIVER, DELAWARE

PROJECT: The original project was adopted in 1879, and a subsequent project was adopted as Ex. D. 52-57 in 1892 and modified in 1893 and 1895. The existing project was adopted as HD 56-102 in 1907 and modified as HD 62-678 in 1919, as HD 74-83 in 1937, and again as SD 81-229 in 1954. It provides for a channel including 7 cutoffs with dimensions and limits as shown; a turning basin at Milford 9 feet deep, 120 feet wide, and 350 feet long.



CHANNEL	DIMENSIONS	
LOCATION	DEPTH	WIDTH
A - B	9 FT.	80 FT.
B - C	9 FT.	60 FT.
CUTOFFS (No. 1, 2, 3, 4, 5, 6, 7	9 FT.	50 FT.

Disposal Areas	Used in F.Y.
(hatched)	64, 65, 76

In F.Y.'s 64 & 65 material was also deposited in contractor furnished areas along the river bank.

Average Annual Dredged Quantities from 1963-1978 are given in C.Y./yr.

FIGURE A-15

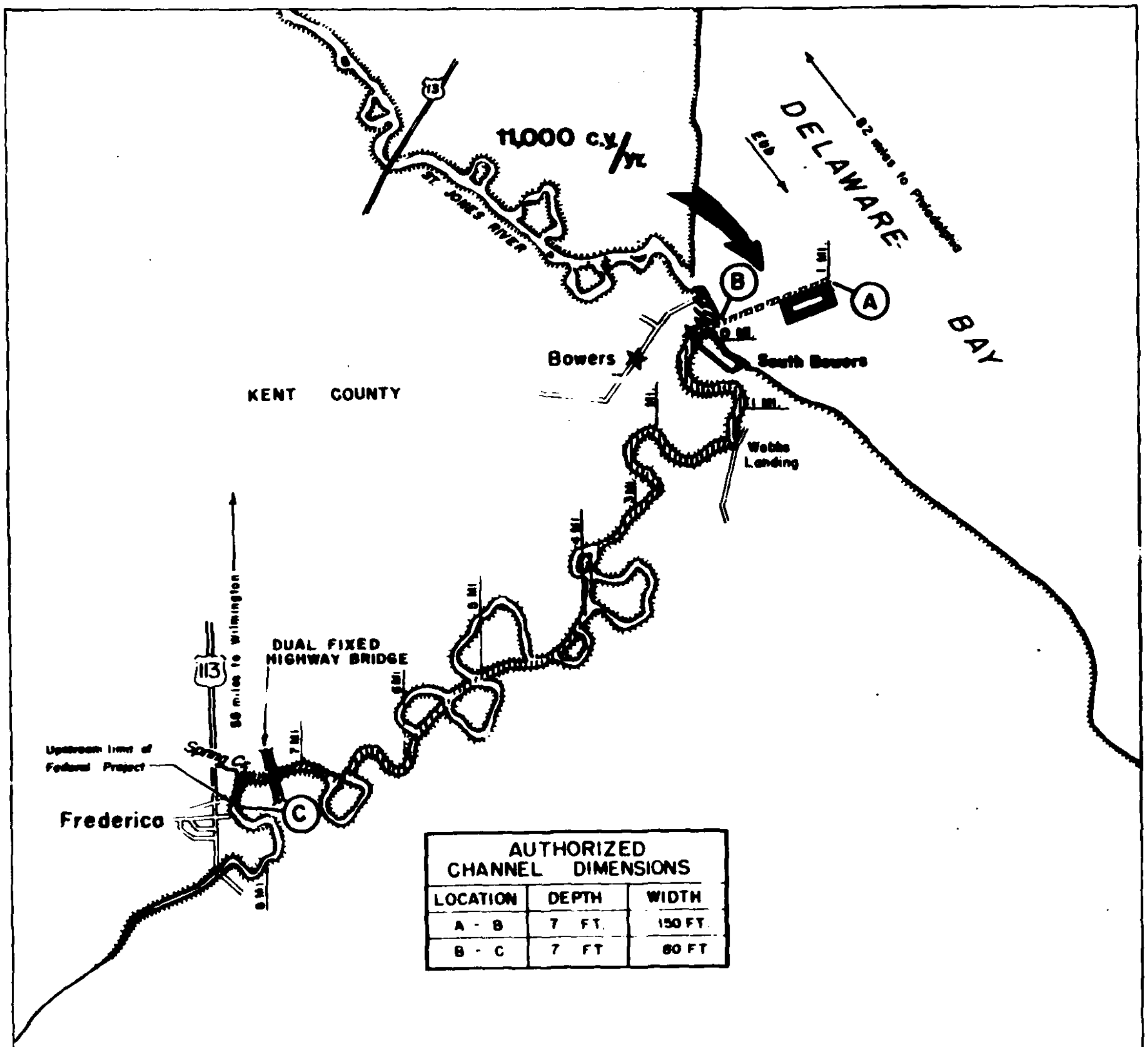
MISPILLION RIVER

DELAWARE

FEDERAL PROJECT LOCATION MAP

MURDERKILL RIVER, DELAWARE

PROJECT: The existing project was adopted as ED-52-21 in 1892. Other reports on Murderkill River are found in HD 62-1058 in 1912, and SD 71-106 in 1930. It provides for a channel from Delaware Bay to Frederica with dimensions and limits as shown, included in the authorized project is a turning basin at Frederica. The project length is about 8½ miles.



AUTHORIZED CHANNEL DIMENSIONS

LOCATION	DEPTH	WIDTH
A - B	7 FT.	150 FT.
B - C	7 FT	80 FT

Disposal Areas	Used in F.Y.
(hatched)	74
(open rectangle)	69
(heavy rectangle)	64, 69, 72, 74, 76

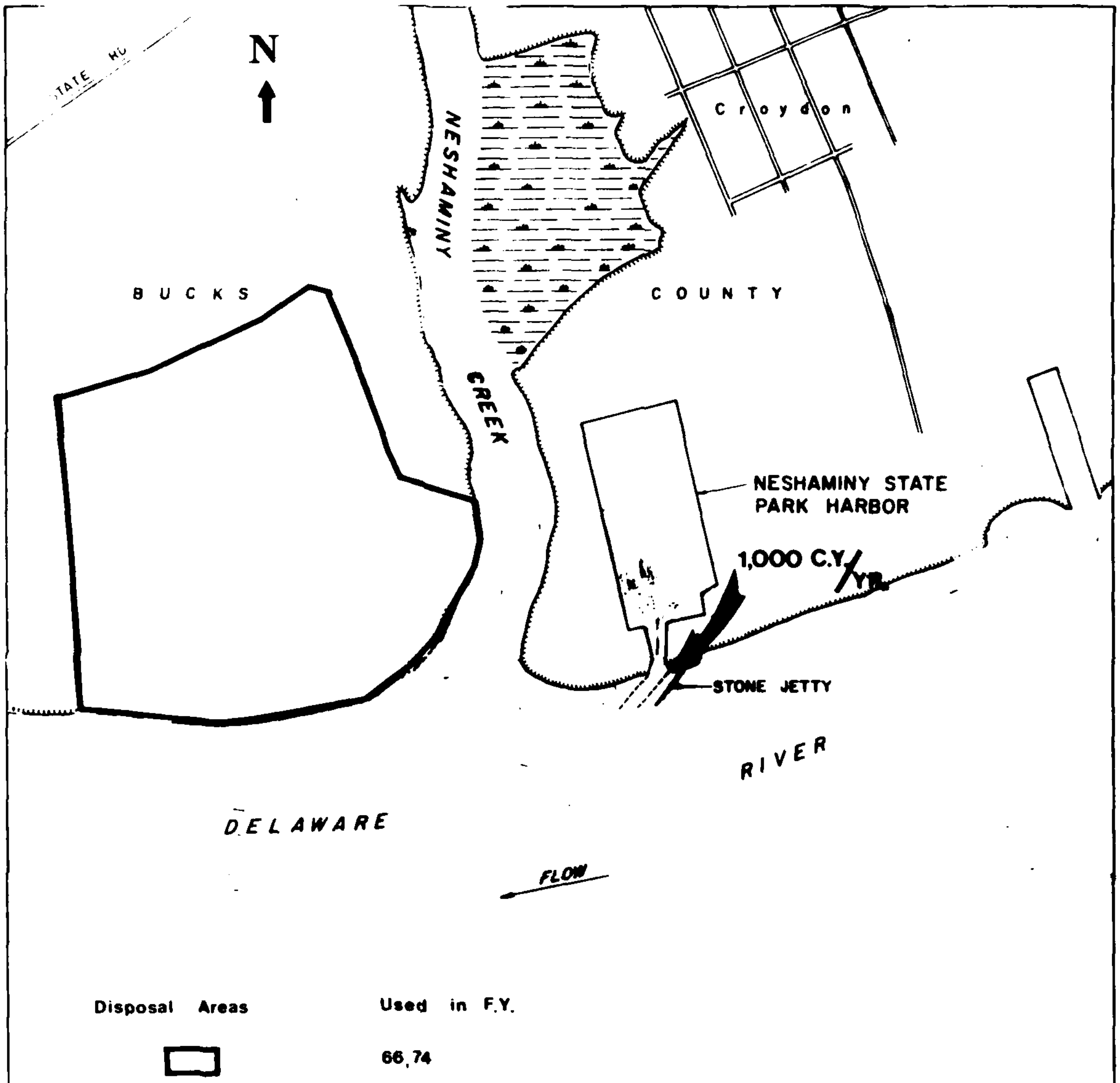
FIGURE A-16
MURDERKILL RIVER
DELAWARE

FEDERAL PROJECT LOCATION MAP

Average Annual Dredged Quantities from 1963 - 1978 are given in C.Y./yr.

NESHAMINY STATE PARK HARBOR, PA.

PROJECT: The existing project was adopted as a Detailed Project Report in 1963 under the small navigation program, Section 107, River and Harbor Act of 1960. It provides for dredging an entrance channel 60 feet wide and 350 feet long from the river to the basin; an access channel 100 feet wide, 760 feet long from basin entrance to a turning basin; an anchorage area 100 feet wide and 760 feet long; a turning basin 200 feet wide and 240 feet long; a stone jetty 230 feet long; and 675 feet of stone revetment. The project depth is 8 feet.

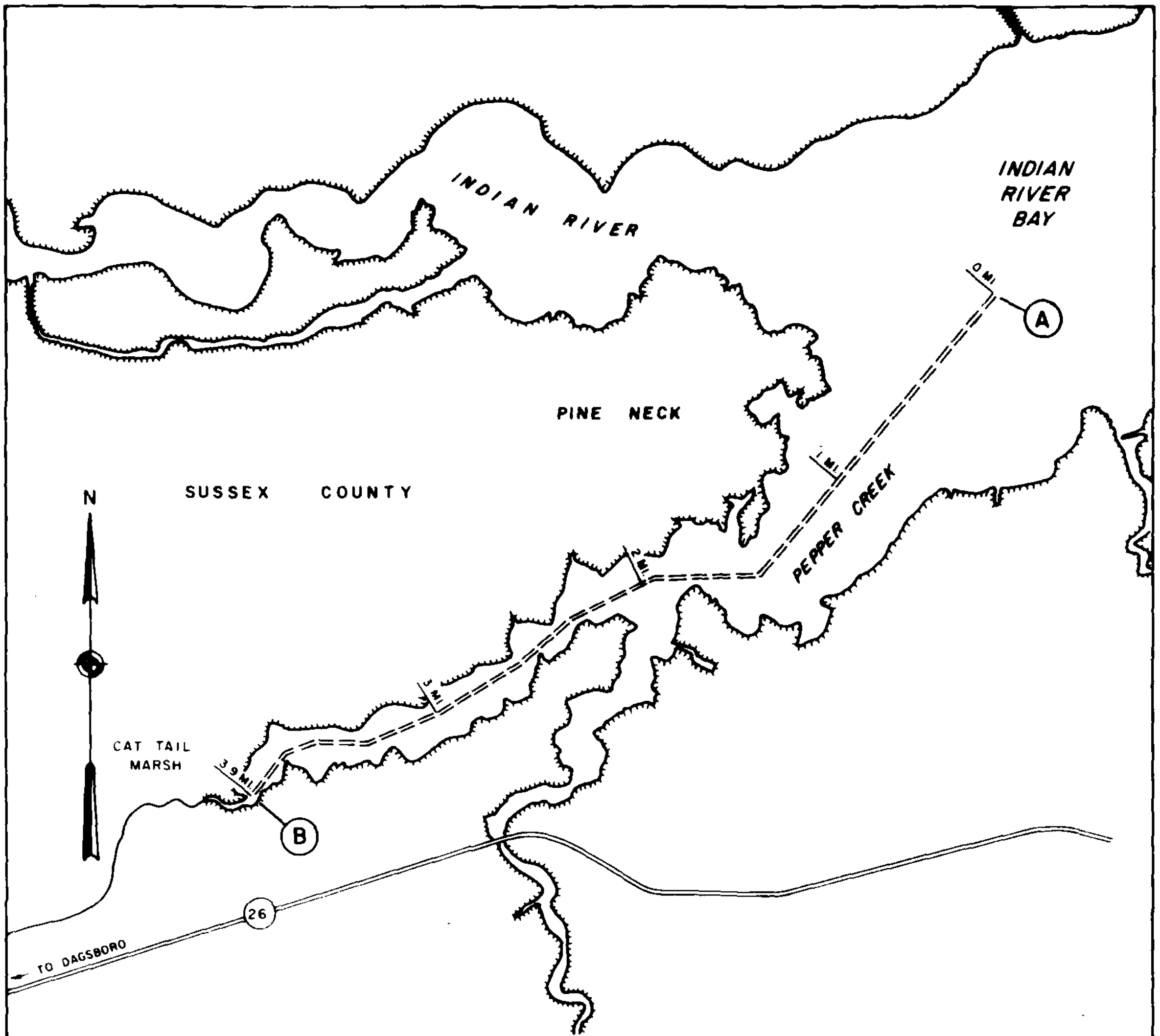


Average Annual Dredged Quantities from
1963-1978 are given in C.Y./yr.

FIGURE A-17
DELAWARE RIVER
NESHAMINY STATE
PARK HARBOR, PA.
FEDERAL PROJECT
LOCATION MAP

PEPPER CREEK, DELAWARE

PROJECT: The existing project was adopted as a Detailed Project Report in 1963 under the small navigation program, Section 107, River and Harbor Act of 1960. It provides for a channel 6 feet deep and 60 feet wide from such depth in Indian River Bay 3.9 miles to Cattail Marsh.



CHANNEL DIMENSIONS		
LOCATION	DEPTH	WIDTH
A - B	6 FT.	60 FT

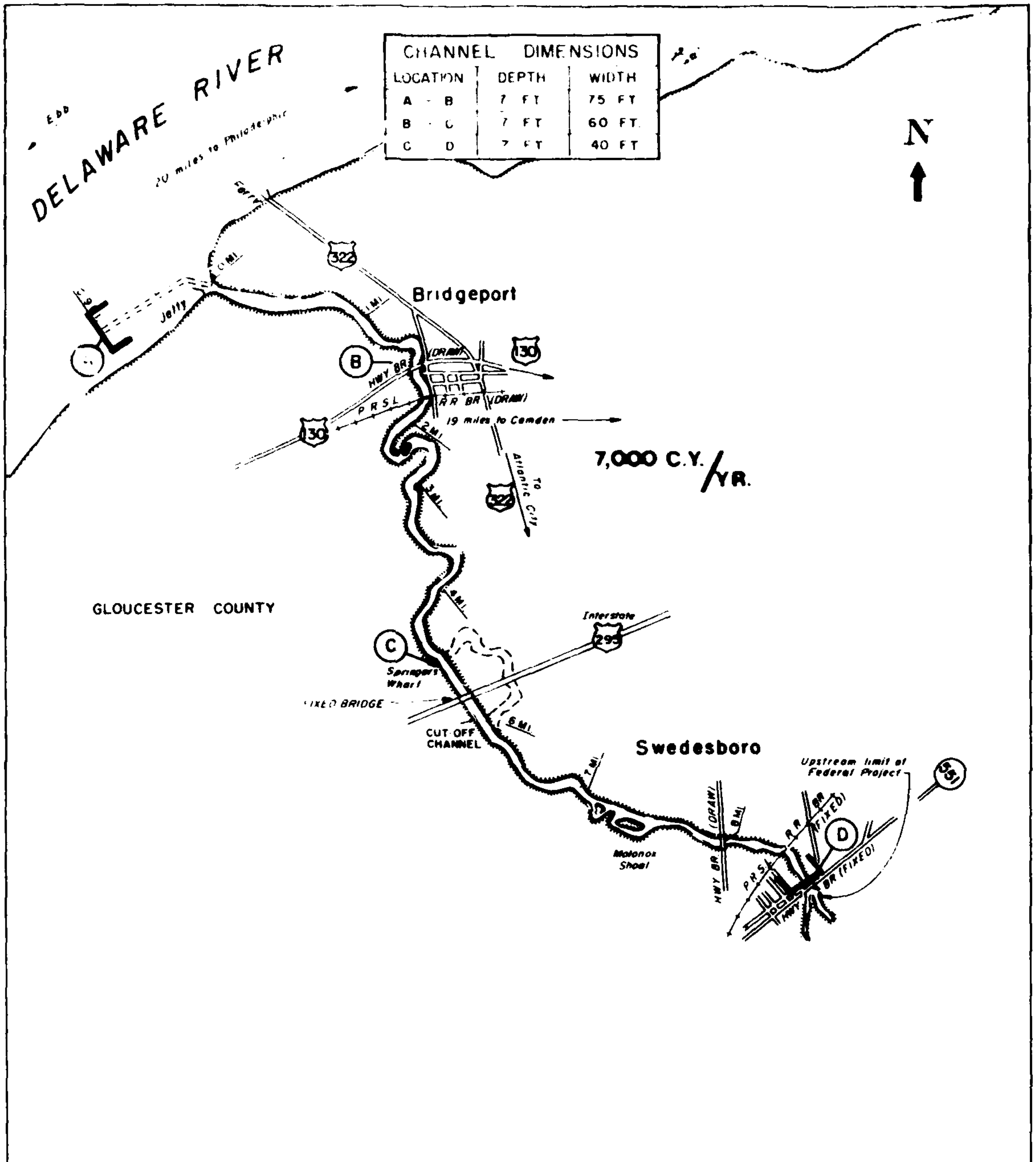
FIGURE A-18
PEPPER CREEK
DELAWARE
FEDERAL PROJECT LOCATION MAP

No maintenance dredging has been done from 1963-1978

RACCOON CREEK, N. J.

PROJECT: The existing project, adopted as HD 56-231 in 1902 and modified in 1907 and as HD 63-800 in 1919, provides for a channel 7 feet deep from Delaware River to the fixed highway bridge at Swedesboro including a cutoff at Molonex Shoal. It also provides for a jetty at the mouth. The project length is about 9-3/4 miles.

(Construction of a fixed bridge and dredging of a cutoff channel approximately 3 miles upstream from the Pennsylvania Reading Seashore Lines Bridge at Bridgeport was accomplished by the State of New Jersey in 1964.)



In F.Y. 65 disposal areas were furnished by contractor.

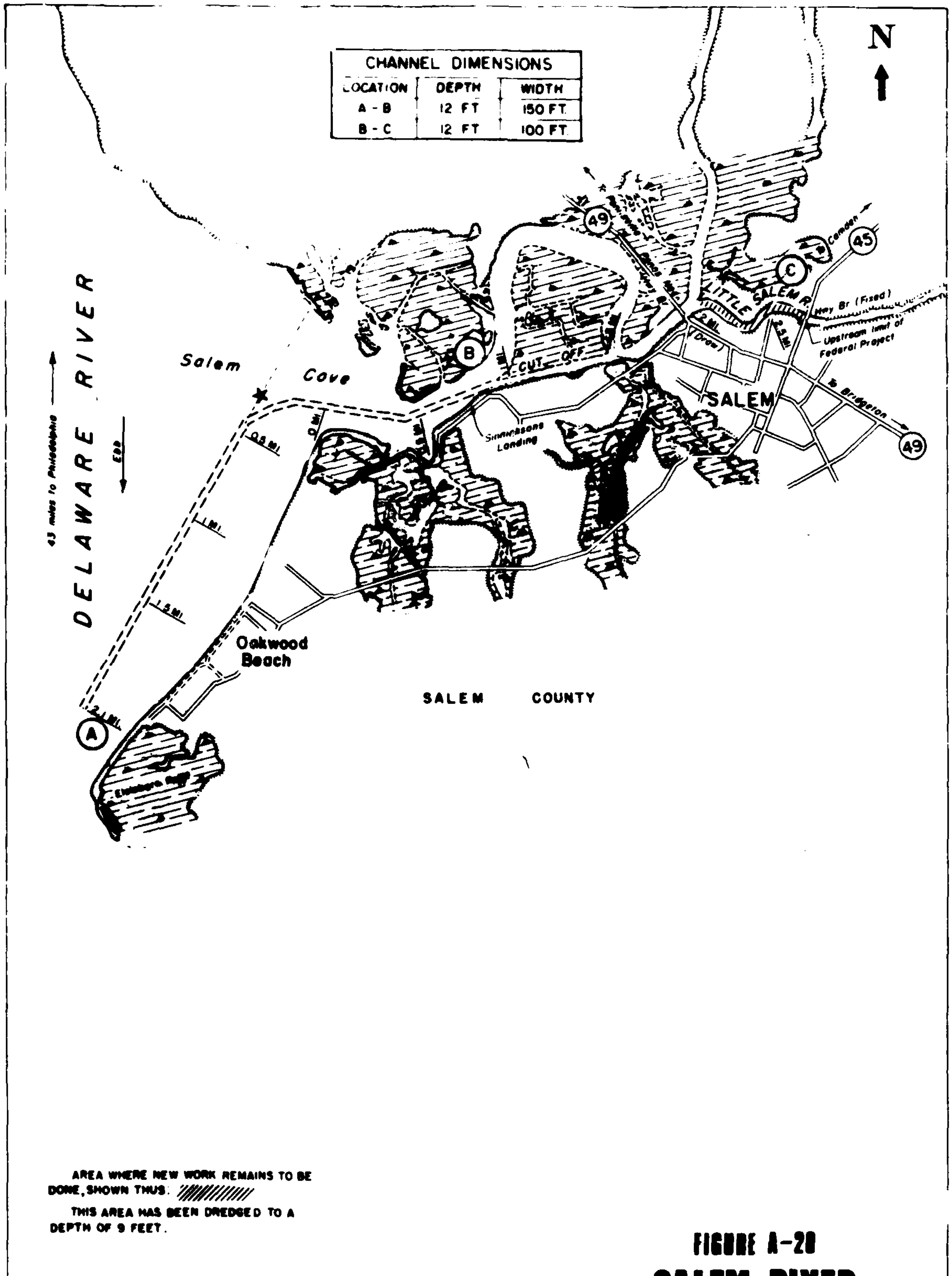
FIGURE A-19
RACCOON CREEK
NEW JERSEY
FEDERAL PROJECT
LOCATION MAP

Average Annual Dredged Quantities from 1963-1978 are given in C.Y./yr.

SALEM RIVER, N. J.

PROJECT: The original project was adopted in 1870, modified in 1878, and a subsequent project was adopted as Rivers and Harbors Committee HD 59-12 in 1907. The existing project, adopted as HD 68-110 in 1925, provides for an entrance channel from the Delaware River to the fixed highway bridge in Salem with dimensions andlimits as shown, including a cutoff. The project length is about 5 miles.

The work remaining to be done, dredging the channel in Little Salem River, has been deferred since it is considered that the additional depth is not required by existing commerce.



LOCATION	DEPTH	WIDTH
A - B	12 FT	150 FT
B - C	12 FT	100 FT

FIGURE A-20

SALEM RIVER
NEW JERSEY

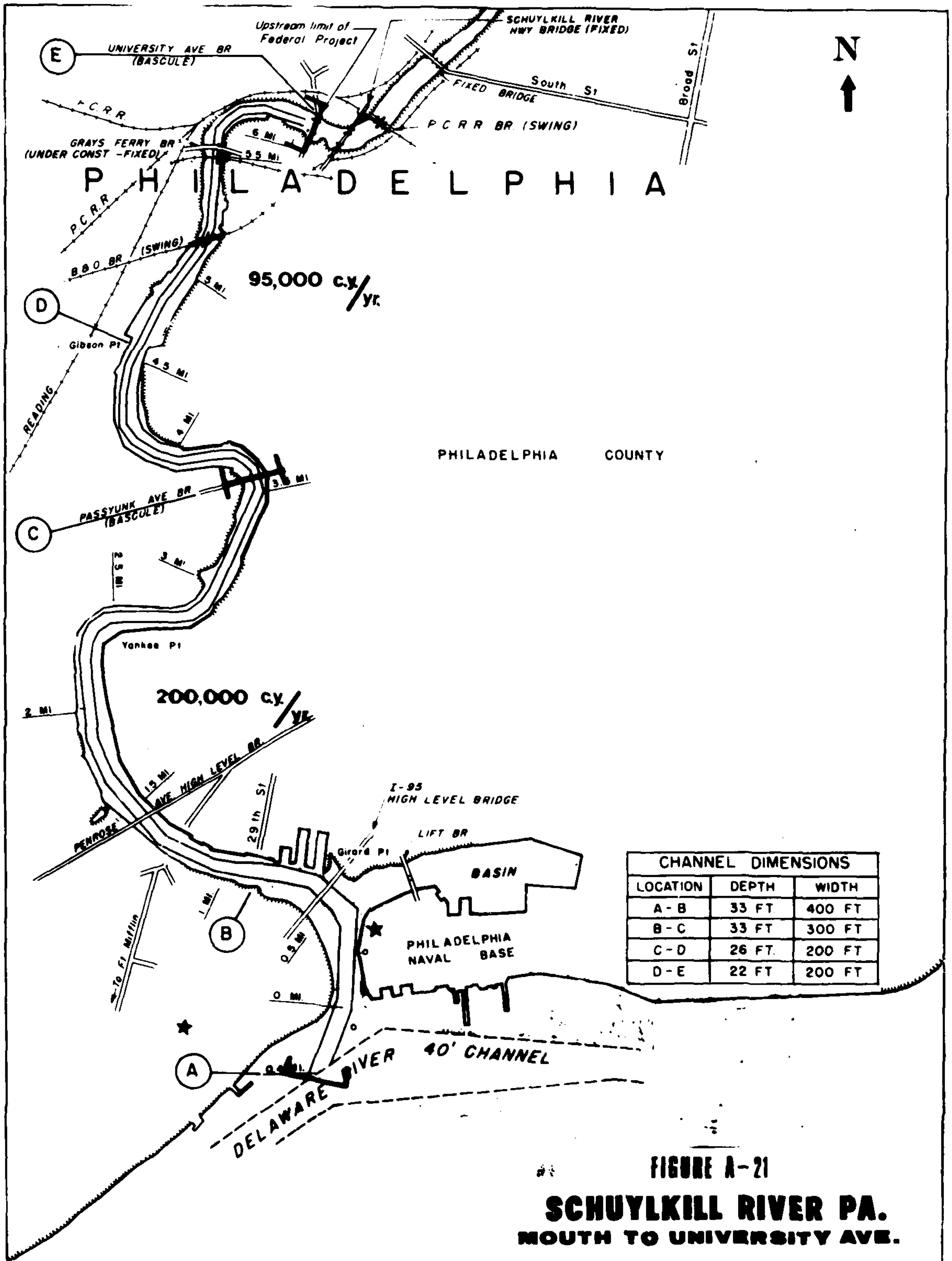
FEDERAL PROJECT
LOCATION MAP

No maintenance dredging has been done from 1963-1978

SCHUYLKILL RIVER, PENNSYLVANIA
MOUTH TO UNIVERSITY AVENUE

PROJECT: The existing project, adopted as House Document 64-1270 in 1917 and modified by House Document No. 71-40 in 1930 and House Document No. 79-699 in 1946 provides for a channel 6.5 miles long and suitably widened at bends with the following dimensions:

Location	Depth	Width
Delaware River to 29th St.	33'	400'
29th St. to Passyunk Ave. Bridge	33'	300'
Passyunk Ave. Bridge to Gibson Point	26'	200'
Gibson Point to University Ave.	22'	200'



CHANNEL DIMENSIONS		
LOCATION	DEPTH	WIDTH
A - B	33 FT	400 FT
B - C	33 FT	300 FT
C - D	26 FT	200 FT
D - E	22 FT	200 FT

FIGURE A-21

SCHUYLKILL RIVER PA.

MOUTH TO UNIVERSITY AVE.

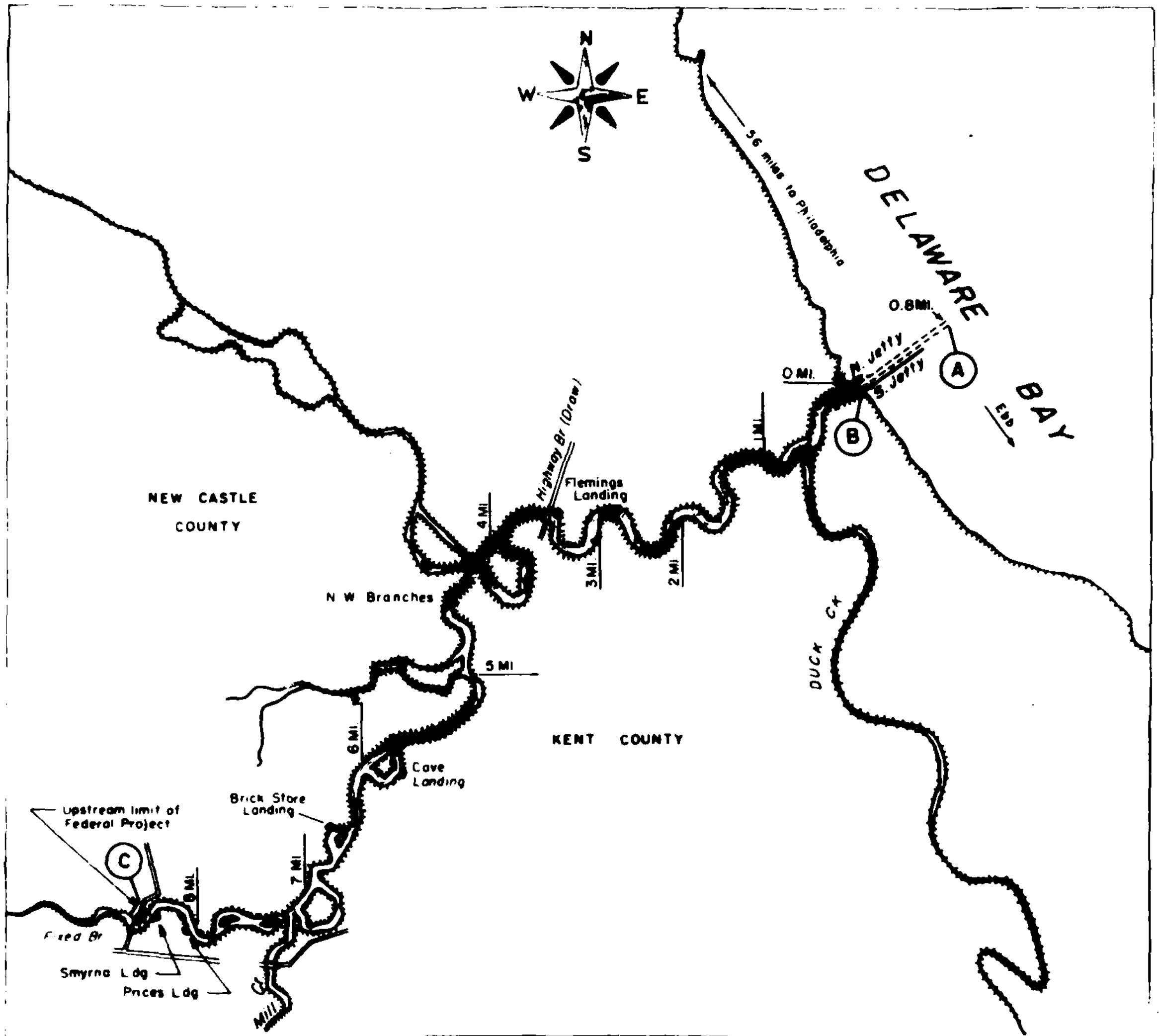
FEDERAL PROJECT LOCATION MAP

Average Annual Dredged Quantities from 1963 - 1978 are given in C.Y./yr.

SMYRNA RIVER, DELAWARE

PROJECT: The existing project, adopted in 1888 and modified by HD 56-90 in 1902 and HD 60-815 in 1910, provides for a channel 7 feet deep from Delaware Bay to Smyrna Landing including 5 cutoffs and the protection of the entrance channel by jetties. The project length is about $9\frac{1}{2}$ miles.

The work remaining to be done is the dredging of the channel to project dimensions from the wharf at Smyrna Landing upstream to the fixed highway bridge. This work has been deferred.



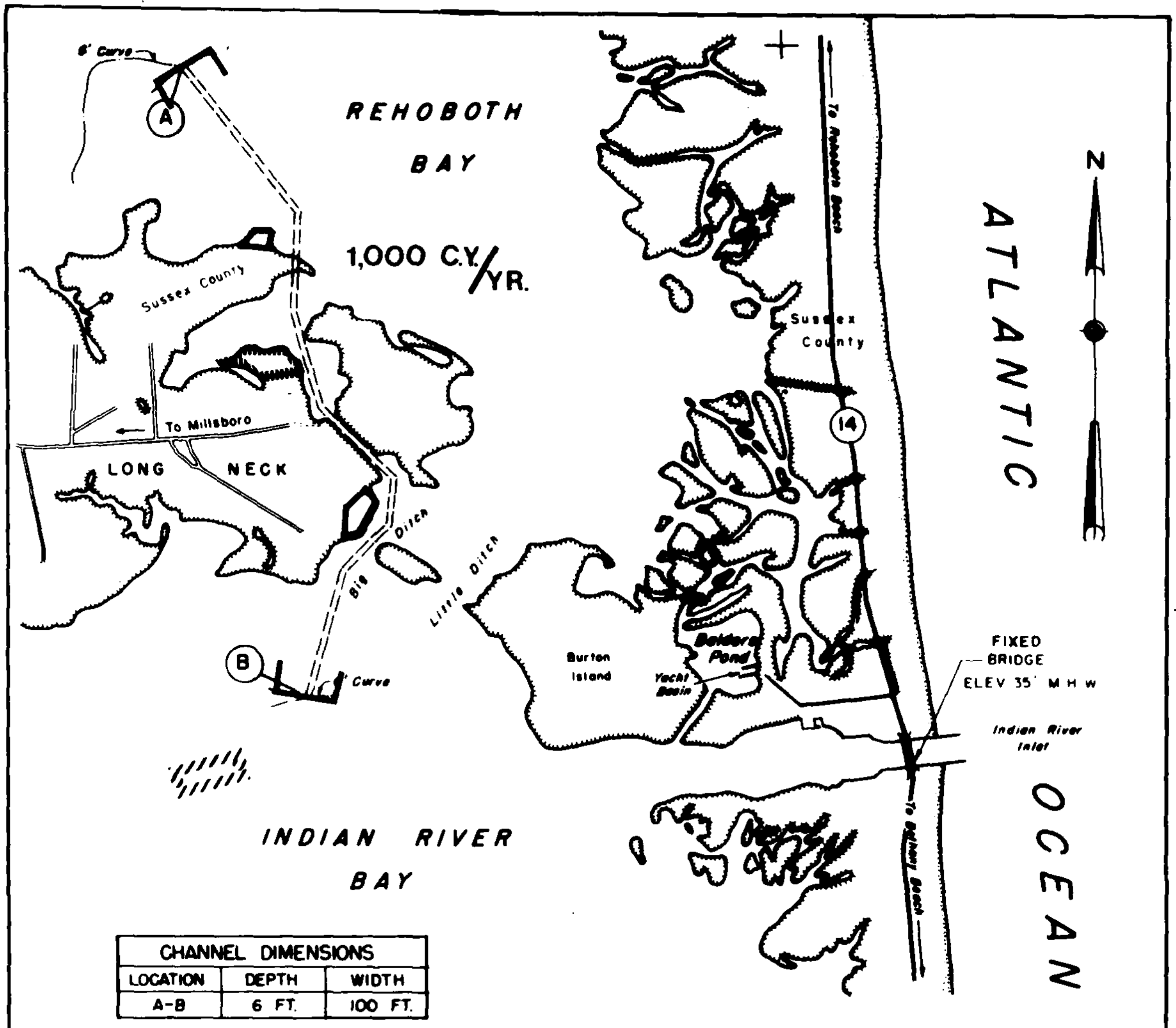
CHANNEL DIMENSIONS		
LOCATION	DEPTH	WIDTH
A - B	7 FT.	100 FT
B - C	7 FT	60 FT

No maintenance dredging has been done from 1963–1978

FIGURE A-22
SMYRNA RIVER
DELAWARE
FEDERAL PROJECT
LOCATION MAP

WATERWAY FROM INDIAN RIVER INLET TO REHOBOTH BAY, DELAWARE

PROJECT: The existing project was adopted as HD 81-304 in 1950. It provides for a channel 6 feet deep and 100 feet wide from Rehoboth Bay to Indian River Bay by way of Big Ditch. The project length is about 2.7 miles.



CHANNEL DIMENSIONS		
LOCATION	DEPTH	WIDTH
A-B	6 FT.	100 FT.

Disposal Areas	Used in F.Y.
(outlined box)	69
(hatched box)	69, 71
(comb-edged box)	71

Average Annual Dredged Quantities from 1963-1978 are given in C.Y./yr.

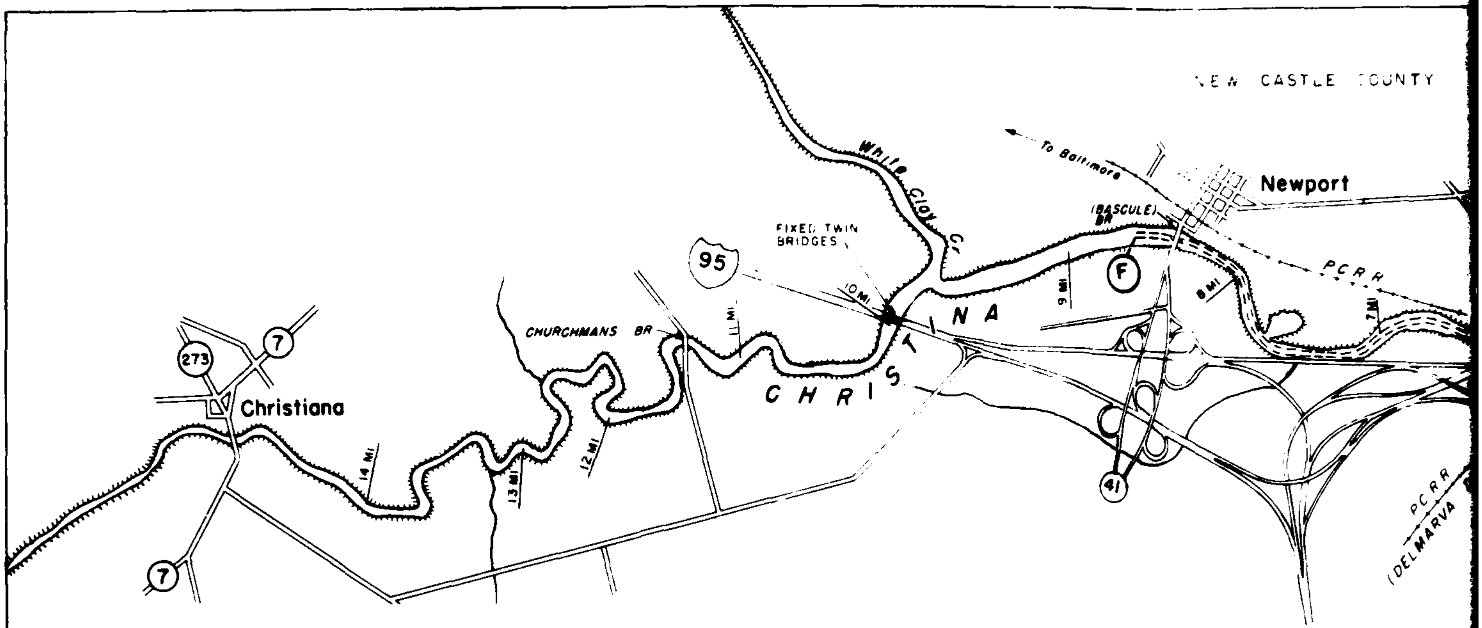
FIGURE A-23

WATERWAY FROM INDIAN RIVER INLET TO REHOBOTH BAY DELAWARE

FEDERAL PROJECT LOCATION MAP

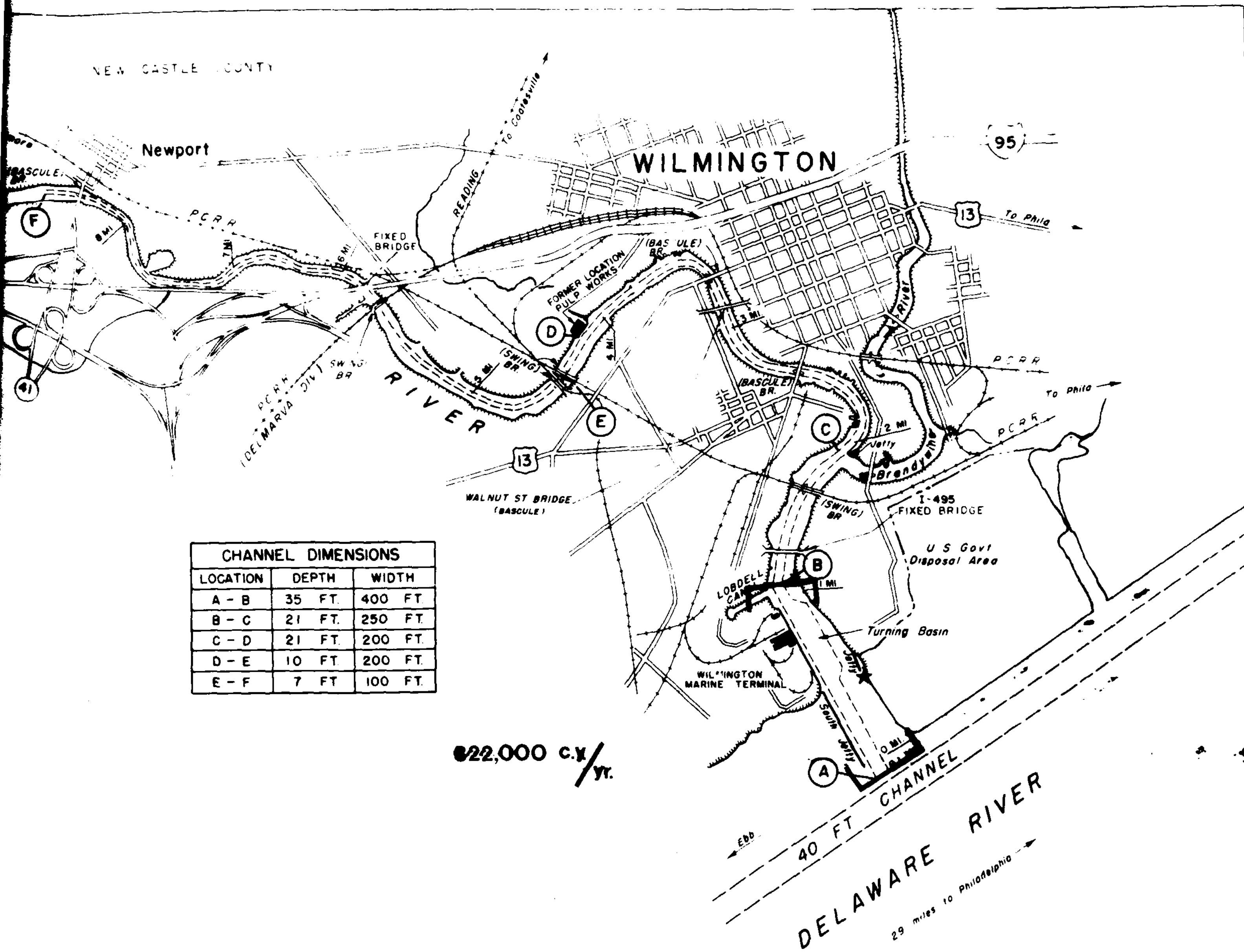
WILMINGTON HARBOR, CHRISTINA RIVER, DELAWARE

PROJECT: The existing project, adopted as HD 54-66 in 1896 and modified in 1899, by HD 67-114 in 1922, by HD 71-20 in 1930, by HD 73-32 in 1935, by HD 76-658 in 1940, and by SD 86-88 in 1960, provides for a channel with depths of 35, 21, 10 and 7 feet from Delaware River to Newport, a turning basin 35 feet deep oppostie the Wilmington Marine Terminal, and jetties at the mouths of Christina and Brandywine Rivers. The project extends from the Delaware ship channel upstream, a length of about 9.9 miles.



CHANNEL	
LOCATION	D
A - B	35
B - C	21
C - D	21
D - E	10
E - F	7

Average Annual Dredged Quantities from
1963 - 1978 are given in C.Y./yr.



CHANNEL DIMENSIONS		
LOCATION	DEPTH	WIDTH
A - B	35 FT.	400 FT.
B - C	21 FT.	250 FT.
C - D	21 FT.	200 FT.
D - E	10 FT	200 FT.
E - F	7 FT	100 FT.

FIGURE A-24

WILMINGTON HARBOR

CHRISTINA RIVER DEL.

FEDERAL PROJECT

LOCATION MAP

L

TABLE A-1

PHILADELPHIA TO SEA PROJECT
- Quantity (Thousands of Cubic Yards)

RANGE	FY 1978	FY 1977	FY 1976 + T Qtr	FY 1975	FY 1974	FY 1973	FY 1972	FY 1971	FY 1970
Philadelphia Harbor									
E (Port Richmond)									
D									
C									
B									
A									
Z									
Y									
X									
W									
V			14.6						
U		37.0							
T									
S									
R									
N-Q						30.5	64.3	22.5	30.4
M						51.8		69.2	98.6
East Horseshoe				326.3					
Horseshoe Bend									
West Horseshoe			72.9						
Mifflin		90.4	67.4					48.1	293.6
Billingsport			49.5						
Little Tinicum Is.		112.6				30.7			40.1
Eddystone		6.9				57.3	295.4		
Chester									
Marcus Hook	1,407.0	2046.8	794.3	278.2	1087.5	361.7	988.9	1308.2	1592.9
Bellevue				88.9		436.0	36.7	469.1	359.9
Cherry Island				262.3	112.4				
Deepwater Point	160.5	415.5	1377.0	884.6	1368.9	887.2	2118.3	1599.9	469.5
Bulkhead Bar	21.2		34.0	5.7	99.5	13.5	190.7	45.2	38.6
New Castle	613.1	292.3	1648.8	671.2	1039.7	1022.9	1406.4	755.6	1250.5
Reedy Island				16.0		17.2		313.0	
Baker									
Liston	443.0	70.0	230.7		436.4			124.0	
Cross Ledge									
Miah Maull									396.7
Brandywine						17.8			

TABLE A-1 (Cont.)

PHILADELPHIA TO SEA PROJECT
- Quantity (Thousands of Cubic Yards)

	FY 1969	FY 1968	FY 1967	FY 1966	FY 1965	FY 1964	FY 1963	Total	Avg. (16 yrs.)
Philadelphia Harbor									
E (Port Richmond)									
D									
C									
B									
A									
Z									
Y									
X									
W									
V									
U									
T									
S									
R								1277.7	79.86
N-Q	166.7	6.5	4.5						
M	189.9	74.6							
East Horseshoe									
Horseshoe Bend									
West Horseshoe	17.4								
Mifflin									
Billingsport			68.8	164.5	188.0	290.3	307.4	1568.0	98.00
Little Tinicum Is.	5.1								
Eddystone						27.4	187.5		
Chester			19.5	201.1				994.1	62.13
Marcus Hook	1566.7	4491.7	2376.1	2095.6	1207.4	10.5			
Bellevue			405.1	778.9	205.0	2593.0	4482.7	32809.8	2050.61
Cherry Island	336.0	304.9	134.6		201.3				
Deepwater Point	989.5	1361.8	130.9	641.2	660.4	1040.5	930.3		
Bulkhead Bar	32.5						218.4	26831.8	1676.99
New Castle	720.9	467.3	559.0	281.3		367.5			
Reedy Island		13.3							
Baker						34.2	30.7	424.4	26.52
Liston									
Cross Ledge								1306.1	81.63
Miah Maull					166.8	389.6		953.1	59.57
Brandywine					562.5	690.4	384.0	1654.7	103.73
							Totals	67819.7	4238.73

TABLE A-2

PHILADELPHIA TO SEA PROJECT ANCHORAGES
-Quantity (Thousands of Cubic Yards)

	FY 1978	FY 1977	FY 1976 & T Qtr	FY 1975	FY 1974	FY 1973	FY 1972	FY 1971	FY 1970
Bombay Hook Point									
Artificial Island									
Reedy Point - SE*									
Reedy Point - N									
Pea Patch Island									
Deepwater Point*									
Marcus Hook*	577.6						567.8		
Thompson Point									
Mantua Creek*									
Naval Base (League Island)									
Gloucester*									
Gloucester-Camden (Greenwich)									
Camden (Cooper Point)									
Port Richmond*									
Petty Island									
5-Mile Point									
Big Stone Beach (near Mispillion)									

* Only six authorized for improvement; other designated only.

TABLE A-2 (Cont.)

PHILADELPHIA TO SEA PROJECT ANCHORAGES
- Quantity (Thousands of Cubic Yards)

	FY 1969	FY 1968	FY 1967	FY 1966	FY 1965	FY 1964	FY 1963	Total	Avg. (16 yrs).
Bombay Hook Point									
Artificial Island									
Reedy Point - SE*									
Reedy Point - N									
Pea Patch Island									
Deepwater Point*									
Marcus Hook*				117.7 1/	116.3 2/	46.5 3/		1425.9	89.12
Thompson Point									
Mantua Creek*					1303.2	417.0		1720.2	107.51
Naval Base (League Island)									
Gloucester*									
Gloucester-Camden (Greenwich)									
Camden (Cooper Point)									
Port Richmond*					331.0		897.7	1228.7	76.79
Petty Island									
5-Mile Point									
Big Stone Beach (near Mispillion)									
							Totals	4374.8	273.42

* Only six authorized for improvement; others designated only.

1/ NW - 7692.0
2/ NW - 7800.0
3/ NW - 1176.2

NW = New Work

TABLE A-3
PHILADELPHIA TO TRENTON PROJECT
- Quantity (Thousands of Cubic Yards)

RANGE	FY 1978	FY 1977	FY 1976 + T Qtr	FY 1975	FY 1974	FY 1973	FY 1972	FY 1971	FY 1970
Fisher Point									
Fisher Channel									
Draw Channel					37.3				
Delair									
Bridesburg Channel									
Frankford Channel									
Tacony Channel									
Torresdale									
Mud Island									
Enterprise									
Beverly Channel									
Edgewater Channel							791.7		
Devlin Channel									
Lehigh Channel									
Burlington Island -Back Channel		313.0	517.2	680.6					
Canal Channel									
Bristol									
Keystone									
Landreth Channel									
Florence Bend									
Florence									
Roebling	543.8								650.0
Kinkora									
Penn Channel						6.4	465.6		
Newbold Channel									
Blake Channel									
Whitehall									
Raritan Channel									
Bordentown									
Duck Island									
Perriwig Channel			240.5						
Biles Island Channel									
Cochran Channel									
Moon Channel									
Trenton Channel									

TABLE A-3 (Cont.)

PHILADELPHIA TO TRENTON PROJECT
- Quantity (Thousands of Cubic Yards)

RANGE	FY 1969	FY 1968	FY 1967	FY 1966	FY 1965	FY 1964	FY 1963	Total w/o NW	Avg. (16 yrs)
Fisher Point									
Fisher Channel									
Draw Channel									
Delair									
Bridesburg Channel				134.7	574.5				
Frankford Channel							1282.4		
Tacony Channel									
Torresdale						1/	2/		
Mud Island									
Enterprise									
Beverly Channel									
Edgewater Channel						3/	4/		
Devlin Channel						87.5	116.8	10,098.8	631.18
Lehigh Channel									
Burlington Island									
-Back Channel	1211.0						5/		
Canal Channel									
Bristol									
Keystone									
Landreth Channel				1083.0	91.0				
Florence									
Roebling						1512.3			
Kinkora									
Penn Channel									
Newbold Channel									
Blake Channel									
Whitehall									
Raritan Channel									
Bordentown									
Duck Island								2392.2	149.51
Perriwig Channel									
Biles Island Channel						2151.7			
Cochran Channel									
Moon Channel									
Trenton Channel									
							Totals	12491.0	780.69

1/ NW - 0.8
2/ NW - 237.1
3/ NW - 204.1
4/ NW - 272.5
5/ NW -2011.0

NW = New Work

TABLE A-4

OTHER FEDERAL PROJECTS
- Quantity (Thousands of Cubic Yards)

PROJECT	FY 1978	FY 1977	FY 1976 T Qtr	FY 1975	FY 1974	FY 1973	FY 1972	FY 1971	FY 1970
Schuylkill River -26' channel			166.3		229.5		354.8	339.8	
-33' channel		40.3	239.0	505.8		237.7	31.0	1157.5	
Little River					49.5				
Murderkill River	18.6		32.1		24.8		44.7		
Mispillion River			8.1						
Broadkill River									
Harbor of Refuge									
Cooper River									
Big Timber Creek									
Mantua Creek									
Raccoon Creek									
Salem River									
Cohansey River									
Nechaminy State Park Harbor					14.2				
Maurice River									
Smyrna River									
Wilmington Harbor -35' channel	1115.3	730.4	480.7	755.8	909.2	600.0	731.2	1144.6	
Del. Riv.-Camden									
Inland Waterways									
-Rehoboth Bay to Del. Bay				86.6					39.5
-Indian Riv. Inlet to Rehoboth Bay								15.6	
Indian River Inlet & Bay								22.9	
Pepper Creek									

TABLE A-4 (Cont.)

OTHER FEDERAL PROJECTS

- Quantity (Thousands of Cubic Yards)

PROJECT	FY 1969	FY 1968	FY 1967	FY 1966	FY 1965	FY 1964	FY 1963	Total w/o NW	Avg. (16 yrs.)
Schuylkill River -26' channel	242.2	5.0			159.6	30.1		1527.3	95.46
-33' channel			393.9		241.1		352.0	3198.3	199.89
Little River				37.4				86.9	5.43
Murderkill River	31.3					32.4		183.9	11.49
Mispillion River					128.6	54.7		191.4	11.96
Broadkill River				89.7	7.4			97.1	6.07
Harbor of Refuge						338.9	30.0	368.9	23.06
Cooper River								0	0
Big Timber Creek								0	0
Mantua Creek							108.8	108.8	6.80
Raccoon Creek					104.9			104.9	6.56
Salem River								0	0
Cohansey River				179.7				179.7	11.23
Neshaminy State Park Harbor				1/				14.2	0.89
Maurice River								0	0
Smyrna River								0	0
Wilmington Harbor -35' channel	1202.3	1235.5		1169.7	950.0	985.1	1146.0	13155.8	822.24
Delaware River at Camden							74.3	74.3	4.64
Inland Waterways									
-Rehoboth Bay to Del. Bay					129.4	48.7	0	304.2	19.01
-Indian Riv. Inlet to Rehoboth Bay	6.5							22.1	1.38
Indian River Inlet & Bay	80.4							103.3	6.46
Pepper Creek						2/		0	0
							Totals	19721.1	1232.57

1/ NW - 328.1 NW = New Work

2/ NW - 195.0

Federal Grand Total 104406.6 6525.41

NON-FEDERAL

In researching the Federal permit files for non-Federal dredging, it was determined that from 1963 to the present, approximately 225 permits were issued for "new work" and maintenance dredging in the study area, of which 125 indicated the quantities of material to be removed. These quantities alone yield an average annual dredged quantity of about 1.5 million cubic yards. Of the 100 or so permits that contained no quantity figures, more than half appeared to be of the smaller category where the quantity of material dredged would be small (less than 1000 cubic yards). Thus, an increase from 1.5 to 2.0 seems reasonable for an approximation of the average annual dredged quantity performed under all 225 permits.

In examining this figure of 2.0 million cubic yards per year it must be realized that a large percentage was "new work" dredging that was performed in developing the river front or for use as beach fill. Maintenance dredging is estimated to be about one-third of this, or 0.66 million cubic yards. The exact breakdown is not known, therefore future study efforts will necessarily require more accurate non-Federal maintenance dredging data collection.

A major non-Federal public project not included in these totals is Wilmington Harbor. The Port of Wilmington generally employs the contractor dredging the Federal navigation channel to dredge adjacent to its dock, which is outside the limits of the Federal channel. The Port pays the Corps a fee for use of the Edgemoor and Wilmington Harbor disposal areas; the current charge is $0.25/cubic yard. The quantities of material dredged in recent years are as follows:

FY 1978	-	65,000 cubic yards
FY 1977	-	48,000 cubic yards
FY 1976	-	26,000 cubic yards
FY 1975	-	17,000 cubic yards

This averages out to almost 40 thousand cubic yards per year of maintenance dredging.

Other accurate records of non-Federal quantity removal exist in the form of American Dredging Company's bi-monthly logs. American Dredging Company (A.D.Co.), the largest private dredging firm in the study area, performs maintenance dredging for approximately forty-five companies under a "blanket" permit issued to them by the Philadelphia District in 1973. In the six year tenure of this permit they have removed 10.8 million cubic yards in the Delaware and Schuylkill Rivers, for an average of 1.8 million cubic yards per year.

This figure, along with the average amount dredged from the Port of Wilmington, yield a known total of 1.84 million cubic yards per year of maintenance dredging. Together with the dredging work covered by the other 225 permits, a sum total of 2.5 million cubic yards per year seems like a reasonable approximation of the total non-Federal maintenance dredging being performed in the study area.

Adding this to the Federal figure of over 6.5, yields an average annual quantity of over 9.0 million cubic yards of maintenance dredging

The disposal area that A.D.Co. fills known as White's Basin, is shown on Figure A-6 along with other existing Federal sites. The remaining capacity depends on the outcome of a court decision as to how much of their property may be filled in with dredging spoil. In regards to the disposal areas used to perform work under the other 225 permits, it appears as though a large percentage of the dredged material was disposed on site as fill. Along with those cited earlier, further efforts are needed to determine whether non-Federal interests will be able to provide suitable disposal areas for their future dredging requirements.

TABLE A-5

Delaware River Projects (Navigation)

	Title	Document	Year Printed	Responsibility for Disposal Sites
1.	Delaware River at Camden	HD 63-1120	1914	None stated
2.	Delaware River between Philadelphia and the Sea	HD 76-580	1940	None stated
3.	Delaware River at Trenton	HD 61-839	1910	Land required by locals
4.	Delaware River between Philadelphia and the Sea	SD 75-159	1938	None
5.	Delaware River between Phila., Pa., and Trenton, NJ (Delanco)	HD 74-90	1936	Local interests had furnished with regard to 20 ft. project (HD 68-228)
6.	Examination and Survey of Delaware River (Phila. to Sea)	HD 61-733	1910	No mention but appears Federal
7.	Delaware River between Phila., Pa. and Trenton, NJ	HD 73-11	1933	Furnished by local interests
8.	Delaware River between Phila., Pa. and Trenton, NJ and Phila. to the Sea	HD 83-358	1954	None - Phila. to Sea Locals - Phila. to Trenton
9.	Delaware River from Phila., Pa., and Trenton, NJ (Channel East of Burlington Island)	HD 74-66	1935	Locals
10.	Delaware River from Phila., Pa., to Deep Water in Delaware Bay	HD 56-91	1899	Federal

TABLE A-5 (Cont.)

Delaware River Projects (Navigation)

	Title	Document	Year Printed	Responsibility for Disposal Sites
11.	Delaware River in the Vicinity of Camden, NJ	HD 77-353	1941	None stated
12.	Delaware River, NJ (Camden)	HD 70-111	1927	No local cooperation for disposal basins
13.	Delaware River, PA and NJ	HD 73-5	1933	None stated
14.	Delaware River, Pa. and NJ, Phila. to Trenton	HD 68-228	1924	Locals and bulkheaded if necessary
15.	Delaware River, Pa. and NJ, Phila. to Trenton	HD 71-3	1929	Cash in lieu of disposal areas by locals
16.	Delaware River, Pa., and NJ	HD 61-702	1910	None stated
17.	Delaware River, Pa., NJ and DE	HD 71-304	1930	None stated
18.	Delaware River, Phila. to Sea, Anchorages	HD 85-185	1957	None stated
19.	Delaware River, Vicinity of Biles Creek, Pa.	HD 79-679	1946	Locals
20.	Schuylkill River, Pa.	HD 71-40	1930	None stated, but locals maintain above Passyunk Ave. due to lack of sewage control
21.	Schuylkill River, Pa.	HD 79-699	1946	None stated

TABLE A-5 (Cont.)

Delaware River Projects (Navigation)

	Title	Document	Year Printed	Responsibility for Disposal Sites
22.	Schuylkill River, Pa. from Delaware River to South Street Bridge	HD 64-1270	1916	None stated
23.	Wilmington Harbor, DE	HD 62-359	1912	None stated
24.	Wilmington Harbor, DE	HD 67-114	1921	Locals for bulkhead on north side
25.	Wilmington Harbor, DE	HD 71-20	1930	Locals provide bulkheaded disposal area for original dredging
26.	Wilmington Harbor, DE	HD 73-32	1934	None stated
27.	Wilmington Harbor, DE	HD 76-658	1940	None stated
28.	Wilmington Harbor, DE	SD 86-88	1960	Corps

TABLE A-6

Other Federal Projects (Navigation)

Title	Document	Year Printed	Responsibility for Disposal Sites
Mantua Creek, NJ	HD 75-505	1938	Locals
Big Timber Creek, NJ	HD 73-15	1933	Locals
Neshaminy State Park Harbor, PA	DPR(same title)	1963	Locals
Mispillion River, Del.	SD 81-229	1950	Locals
Little River, Del.	HD 62-626	1912	Locals
Delaware River at Camden, NJ	HD 77-353	1941	None Stated
Murderkill River, Del.	HD 62-1058	1912	None Stated
Broadkill River, Del.	HD 59-214	1906	None Stated
Harbor of Refuge, Del. Bay, Del.	HD 74-56	1935	None Stated
Cooper River, NJ	Ex. D. 53-176	1895	None Stated
Raccoon Creek, NJ	HD 63-800	1914	None Stated
Salem River, NJ	HD 68-110	1924	None Stated
Cohansey River, NJ	Sen. Comm. Print 75	1937	Locals
Maurice River, NJ	HD 73-275	1934	None Stated
Smyrna River, Del.	HD 60-815	1908	None Stated

TABLE A-6 (Cont.)

Other Federal Projects (Navigation)
(continued)

Title	Document	Year Printed	Responsibility for Disposal Sites
Indian River Inlet & Bay, Del.	HD 76-330	1939	Locals
Inland Waterway, Rehoboth Bay to Delaware Bay, Del.	HD 77-344	1941	Locals
Waterway from Indian River Inlet to Rehoboth Bay, Del.	HD 81-304	1949	Locals
Pepper Creek, Del.	DPR(same title)	1963	Locals

II. Past Attempts to Locate Alternate Sites

A. Summary of Locations and Problems.

Realizing the diminishing availability of riparian land for use as disposal sites resulting from land-use pressures, motivated by normal regional growth, the Philadelphia District in the late 1950's through the late 1960's embarked on an extensive program to locate and establish additional disposal sites for the Delaware River navigation projects. This program which culminated with the District's Long Range Spoil Disposal Study showed that it is very difficult to select additional disposal sites as close as possible to the major location of shoaling. The results of these efforts are shown in Table A-7 and A-8 and on Figures A-25 to A-27.

TABLE 7
DISPOSAL SITE STATUS
PHILADELPHIA TO SEA

PROJECT	SITE	STATUS
PHILADELPHIA TO SEA	Delaware Bay	Overboard disposal area. Hasn't been used in recent years; mainly used for Brandywine Range.
	Artificial Island NJ-DE	Existing disposal area; Federally owned; portion leased to Public Service Gas and Electric in exchange for National Park; distance from dredging sites restricts use; 29,000,000 c.y. capacity and 20-25 years remaining in small area that is used. Banked Area = 400 acres (B.A.)
	Killcohook NJ-DE	Existing disposal area; Federally owned; some area lost for local road construction purposes; 33,000,000 c.y. capacity and 10-15 years remaining. B.A. = 1182 acres
	Penns Neck NJ	Existing disposal area; Federally owned; 8,000,000 c.y. capacity and 10-15 years remaining. B.A. = 322 acres
	Deepwater NJ	Considered for Deepwater Point Anchorage; eliminated as anchorage is no longer required.
	Lukens Steel Company near New Castle DE	Eliminated from consideration during Long Range Spoil Disposal Study (LRSDS) due to opposition; desired for Deepwater Point Anchorage.
	Church Landing NJ	Eliminated from consideration during LRSDS as it was not considered a practical site due to blockage of beach area.
	Pigeon Point DE	Former Federally leased disposal area; inactive since May 1966 as is filled; extension was considered.
	Wilmington Harbor DE	Existing disposal area; Federally owned and leased; 3,500,000 c.y. capacity and 4-6 years remaining; for Wilmington Harbor project; soil mechanics limiting height. B.A. = 160 acres

TABLE 7 (Cont.)
DISPOSAL SITE STATUS
PHILADELPHIA TO SEA

PROJECT	SITE	STATUS
PHILADELPHIA TO SEA (continued)	Edgemoor DE	Existing disposal area; area A - active; Area B - inactive; Federally leased; 2,500,000 c.y. capacity and 2-4 years remaining. Area B is now location of sewer plant. Banked Area (B.A.) = 230 acres.
	Bellevue DE	Considered but being filled by private interest.
	Helm Cove Carney's Point NJ	Eliminated from consideration during LRSDS due to limited capacity as result of restrictions by DuPont on upland areas; desired for Deepwater Point Anchorage.
	Penns Grove NJ	Existing disposal area; Federally owned; has never been used; 22,000,000 c.y. capacity and 15-20 years remaining; contractor excavating until Sep 79 and will create additional capacity; question over safe depth of excavation. B.A. = 253 acres.
	Pedricktown, NJ (North & South)	Existing disposal area; Federally owned; 38,000,000 c.y. capacity and 15-20 years remaining. B.A. = 1129 acres.
	Oldmans No. 1 NJ	Former disposal area; inactive since Dec 1962 as lease terminated; owned by Sun Oil.
	Oldmans No. 2 NJ	Lease expired March 1972.
	Oldmans Creek, NJ #'s 3 & 4	Eliminated from consideration during LRSDS; Key waterfowl area.
	Sun Oil	Eliminated from consideration during LRSDS as easement was terminated in 1965; might be available at some future date.

TABLE 7 (Cont.)
DISPOSAL SITE STATUS
PHILADELPHIA TO SEA

PROJECT	SITE	STATUS
PHILADELPHIA TO SEA (continued)	Birch Creek NJ	Eliminated from consideration during LRSDS as was not considered economical due to requirement of expensive culvert.
	Center Square NJ	Eliminated from consideration during LRSDS due to lack of availability for purchase or easement as result of local interest problems; and direction of Congress.
	Monsanto Property NJ	Has been used, filled and is developed upon.
	Goose Island NJ	Considered as a prime site during LRSDS; not obtainable due to severe criteria imposed by Monsanto.
	Raccoon Creek NJ	Eliminated from consideration during LRSDS as lease had expired and no renewal was contemplated.
	Cedar Swamp NJ	Eliminated from consideration during LRSDS; owned by A. D. Company and not environmentally acceptable to fill.
	Chester-Monds NJ	Considered as a prime site during LRSDS; land ownership problems between DuPont and State; Corps has never pressed for this site.
	Hercules Powder NJ	Eliminated from consideration during LRSDS as couldn't be obtained.
	Bramell Point NJ (Clonwell Creek)	Eliminated from consideration during LRSDS as couldn't be obtained.

TABLE 7 (Cont.)
DISPOSAL SITE STATUS
PHILADELPHIA TO SEA

PROJECT	SITE	STATUS
PHILADELPHIA TO SEA (continued)	Tinicum Island PA	Considered as a prime site during LRSDS; potential never realized due to problems in obtaining as result of opposition; also considered under Sect. 107 study but opposition terminated the study; problems with Westinghouse.
	Hog Island PA	Previously used; now part of Airport.
	Darby Creek PA	Former disposal area; inactive since Nov 1966; lost for I-95 and Wildlife Refuge (D.O.I.); no remaining capacity.
	Folcroft PA	Eliminated from consideration during LRSDS due to location in wildlife area, desire to give primary consideration to Tinicum Island, and fill restrictions (pipelines).
	National Steel NJ	Eliminated from consideration during LRSDS due to public opposition and problems with National Steel; A. D. Co. used part of this site; desired for Mantua Creek Anchorage; Congress eliminated; rehandling basin leased from Tenneco.
	National Park NJ (Public Service)	Existing disposal area; Federally owned; 6,000,000 c.y. capacity and 15-20 years remaining. Banked Area = 115 acres.
	Fort Mifflin PA	Existing disposal area for Schuylkill River project; Federally owned; 19,000,000 c.y. capacity and 20-25 years remaining. B.A. = 298 acres
	Howell Cove NJ	Eliminated from consideration during LRSDS due to need for immediate release if Texaco required land for plant expansion; lease expired June 1968.

TABLE 7 (Cont.)
DISPOSAL SITE STATUS
PHILADELPHIA TO SEA

PROJECT	SITE	STATUS
PHILADELPHIA TO SEA (continued)	Naval Air Material Center PA (4 sites)	Overboard and land sites; owned by Naval Air Material Center; overboard site used for upriver rock.
	Greenwich Point	
	Petty Island NJ	Owned by Cities Service Co.; used for Port Richmond Anchorage which is no longer needed.
	Baldwin Run NJ	Filled in 1950.
	Pea Patch Island Extension DE	Considered as part of the Delaware City Branch Channel study; public social and environmental opposition terminated this study; problems also with locals concerning impact of additional shipping.

TABLE 8
DISPOSAL SITE STATUS
PHILADELPHIA TO TRENTON

PROJECT	SITE	STATUS
PHILADELPHIA TO TRENTON	#1 Fish House Cove NJ	Designated as a high value waterfowl area by U.S.F. & W.S. not to be filled unless absolutely necessary.
	#A-1	Considered; not available.
	#2 Pennsauken Creek NJ	Furnished by NJ; 1,500,000 c.y. capacity and 15-20 years remaining. Banked Area (B.A.) = 65 acres
	#3 Pennsauken Creek, North NJ	Designated as a high value waterfowl area by U.S.F. & W.S.; has not been filled.
	#4 South of Tacony-Palmyra Bridge NJ	Furnished by NJ; 3,000,000 c.y. capacity and 10-15 years remaining. B.A. = 150 acres
	#5 Palmyra NJ	Designated as a high value waterfowl area by U.S.F. & W.S.; must be preserved. However, U. S. Dept. of Interior maintains that Corps has placed dredged spoil here anyway.
	#6-7W Riverton NJ	Located in front of expensive residential area; use objected to by property owners.
	#8A Pompeston Creek NJ	Designated as a high value waterfowl area by U.S.F. & W.S. U. S. Dept. of Interior maintains that Corps has placed dredged spoil here anyway.
	#8B Wrights Cove	Furnished by NJ; no longer available for use - limiting elevation reached.
	#8W Pennypack Creek PA	Problems with City of Philadelphia in obtaining.
	#9 Swede Creek NJ	Never been used.

TABLE 8 (Cont.)
DISPOSAL SITE STATUS
PHILADELPHIA TO TRENTON

PROJECT	SITE	STATUS
PHILADELPHIA TO TRENTON (continued)	#10A Dredge Harbor	Designated as a high value waterfowl area by U.S.F. & W.S. U. S. Dept. of Interior maintains that Corps has placed material here anyway.
	#10B Dredge Harbor	Used for rock disposal by Amico Sand and Gravel Co.
	#10C Dredge Harbor	Used for rock disposal by Amico Sand and Gravel Co.
	#10D Dredge Harbor	Designated as a high value waterfowl area by U.S.F. & W.S. U. S. Dept. of Interior maintains that Corps has placed material here anyway.
	#10E Dredge Harbor	Designated as a high value waterfowl area by U.S.F. & W.S. U. S. Dept. of Interior maintains that Corps has placed material here anyway.
	#11 Mud Island	Designated as a high value waterfowl area by U.S.F. & W.S. Must be preserved. U. S. Dept. of Interior maintains that Corps has placed material here anyway.
	#11A Jack's or Money Island PA	Never been used.
	#11B Pennsylvania Salt Mfg. Co. PA	Proposed but plant located on site.
	#12 Rancocas River South NJ	Designated as a high value waterfowl area by U.S.F. & W.S. Not to be filled. U. S. Dept. of Interior maintains that Corps has placed material here anyway.
	#12A Hawk Island NJ	Furnished by NJ; 2,000,000 c.y. capacity and 10-15 years remaining. Banked Area (B.A) = 72 acres

TABLE 8 (Cont.)
DISPOSAL SITE STATUS
PHILADELPHIA TO TRENTON

PROJECT	SITE		STATUS
PHILADELPHIA TO TRENTON (continued)	#13	Delanco NJ	Designated as a high value waterfowl area by U.S.F. & W.S. Not to be filled. U. S. Dept. of Interior maintains that Corps has placed material here anyway.
	#13A	Delanco-Beverly	Was filled at one time.
	#14	Delanco-Beverly NJ	Furnished by N. J.; 400,000 c.y. capacity and 3-5 years remaining. Banked Area = 21 acres.
	#15 A&B	Logan Point PA	Owned by Pa.; used for Neshaminy project.
	#16	Neshaminy Creek PA	Has been filled.
	#17	Neshaminy Creek East PA	Designated as a high value waterfowl area by U.S.F. & W.S. Must be preserved.
	#18	Grupp Property PA	Condemned by Pa. in 1958.
	#17-18W	Beverly-Edgewater Park, NJ	Located in front of exclusive residential area. Use objected to by property owners.
	#19	Croydon PA	Owned by Rohn & Haas. Site filled.
	#20	Gary Chemical NJ	Designated as a high value waterfowl area by U.S.F. & W.S. Must be preserved.
	#20W	PA	Owned by Rohm & Haas; developed for industrial use; not available.

AD-A094 799 ARMY ENGINEER DISTRICT PHILADELPHIA PA F/G 13/2
DELAWARE RIVER DREDGING DISPOSAL STUDY, STAGE 1 RECONNAISSANCE --ETC(U)
JUN 79
UNCLASSIFIED DAEN/NAP-10072/RR-79/06 NL

3 OF 12
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A094799

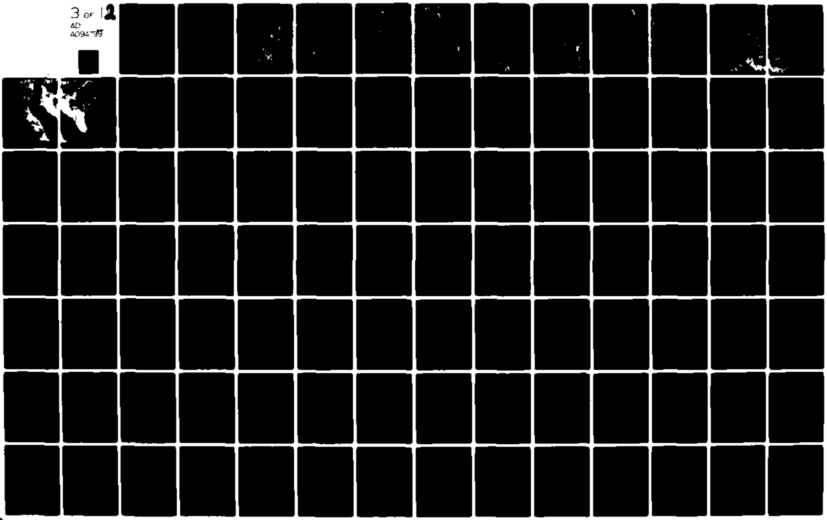
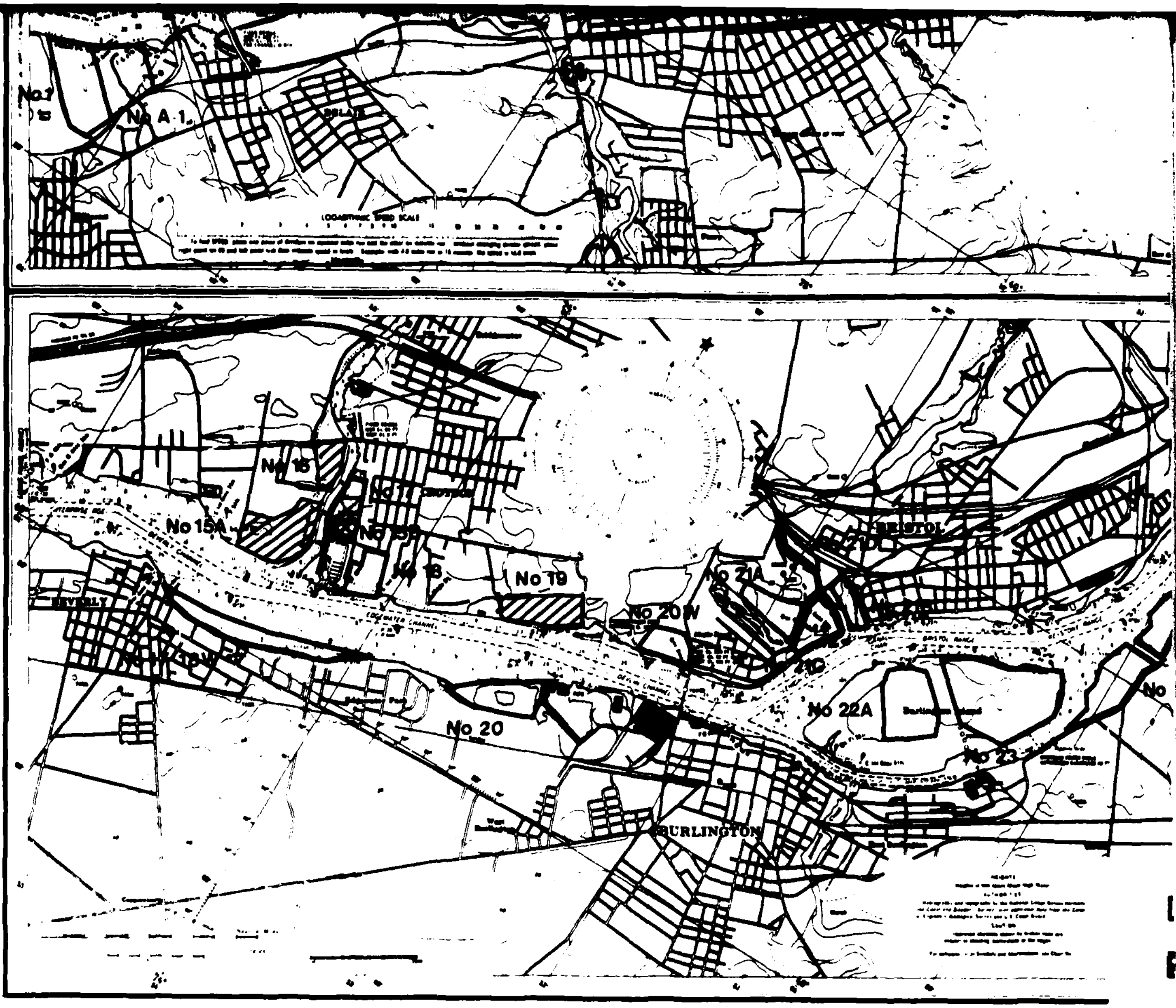


TABLE 8 (Cont.)
DISPOSAL SITE STATUS
PHILADELPHIA TO TRENTON

PROJECT	SITE	STATUS
PHILADELPHIA TO TRENTON (continued)	#21A Rohm & Haas PA	
	#21B Otter-Mill Creek PA	
	#21C Rohm & Haas PA	
	#21D Rohm & Haas PA	
	#22 Burlington Island West	Furnished by NJ; 600,000 c.y. capacity and 5-10 years remaining. Banked Area (B.A.) = 71 acres.
	#22A Burlington Island Central, NJ	Has been used but Corps lost lease.
	#23 Burlington Island East, NJ	Owned by City of Burlington.
	#23A Pheonix Property	Turned down offer of fill.
	#23B Hayes Property	American Dredging Co. Gravel Sites
	#24 Money Island (Warner)	Furnished by PA,; 3,000,000 c.y. capacity and 10-15 years remaining; owned by Warner Gravel Co. B.A. = 249 acres
	#24A,B Money Island (Warner)	
	#24D Pennsbury Manor	Furnished by PA.; 700,000 c.y. capacity and 2-5 years remaining; material hauled out of site. B.A. = 50 acres.

TABLE 8 (Cont.)
DISPOSAL SITE STATUS
PHILADELPHIA TO TRENTON

PROJECT	SITE	STATUS
PHILADELPHIA TO TRENTON (continued)	#25 Newbold Island West NJ	Reserved in accordance with desires of U.S.F. & W.S.; U. S. Dept. of Interior maintains that Corps has placed material here anyway.
	#25A Newbold Island East NJ	Back channel area; reserved in accordance with desires of U.S.F. & W.S. No more fill desired.
	#26 U. S. Steel PA	1 site; furnished by Pa.; active; 2,000,000 c.y. capacity and 15-20 years remaining. Banked Area (B.A.) = 27 acres
	#26A,B U. S. Steel PA	Used in past.
	#26E U. S. Steel PA	
	#27 Duck Island South NJ	Reserved in accordance with desires of U.S.F. & W.S.; title questions.
	#28 Biles Island PA	Federally leased from Pa.; 430,000 c.y. capacity and 15-20 years remaining; U.S. Steel. B.A. = 5C acres. Other areas on the island were former sites.
	#29 Duck Island North NJ	Reserved in accordance with desires of U.S.F. & W.S.
	Silvi Sand & Gravel Falls Twp., PA	Available for 40 ft. project 1963.
	St. Michael's Roman Catholic Church, Levittown, PA	Available for 40 ft. project 1963; proposed in 1959; 30.5 acres.
	Amico Sand & Gravel Falls Twp. PA	Available for 40 ft. project 1963.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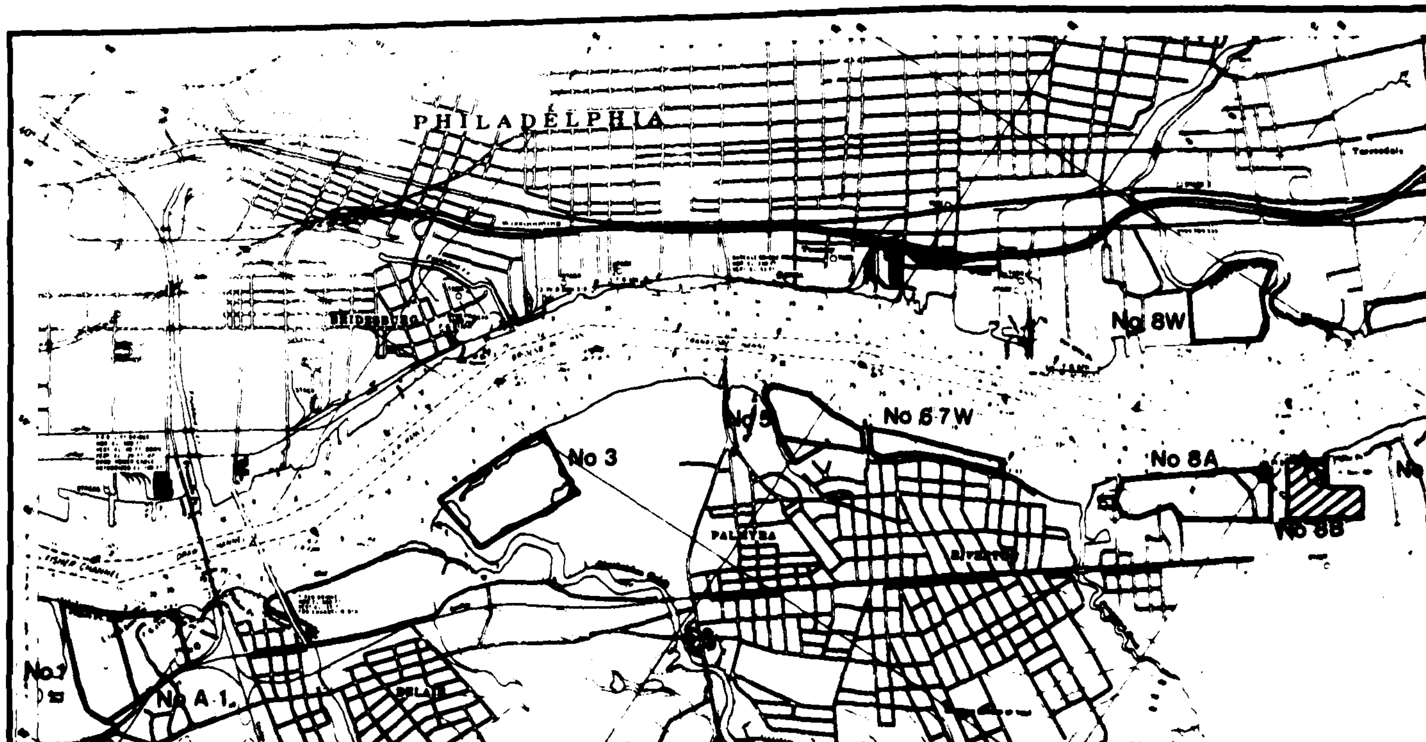
LOGARITHMIC SPEED SCALE
No 15A
No 16
No 17
No 18
No 19
No 20
No 20 W
No 21A
BRISTOL
No 22A
No 23
BURLINGTON


PHILADELPHIA
BRIDESBURG
No 8W
No 5
No 5-7W
No 3
PALMYRA
RIVERTON
No 8A
No 8B
No 1
No A-1
DELAIR
Torresdale

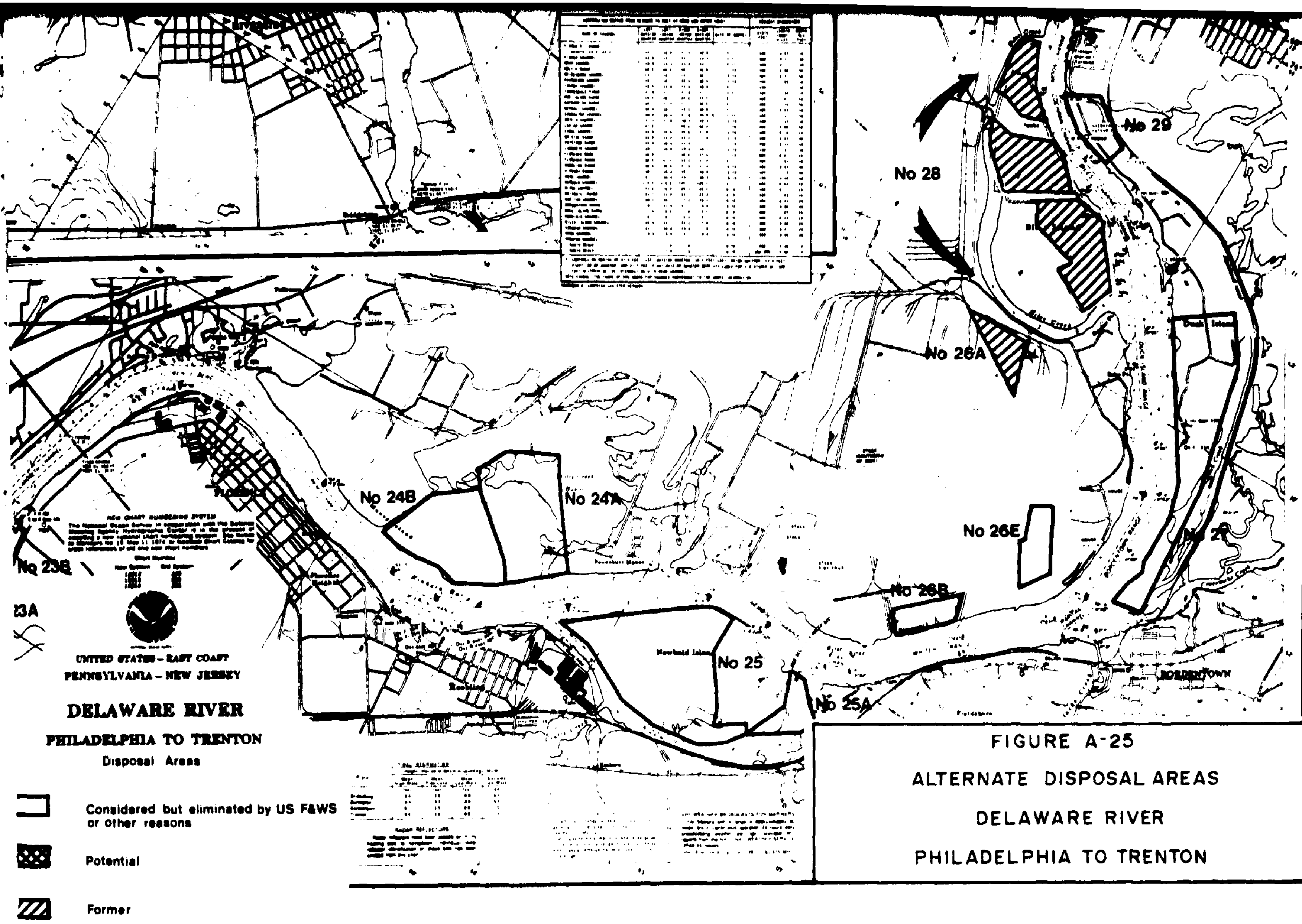
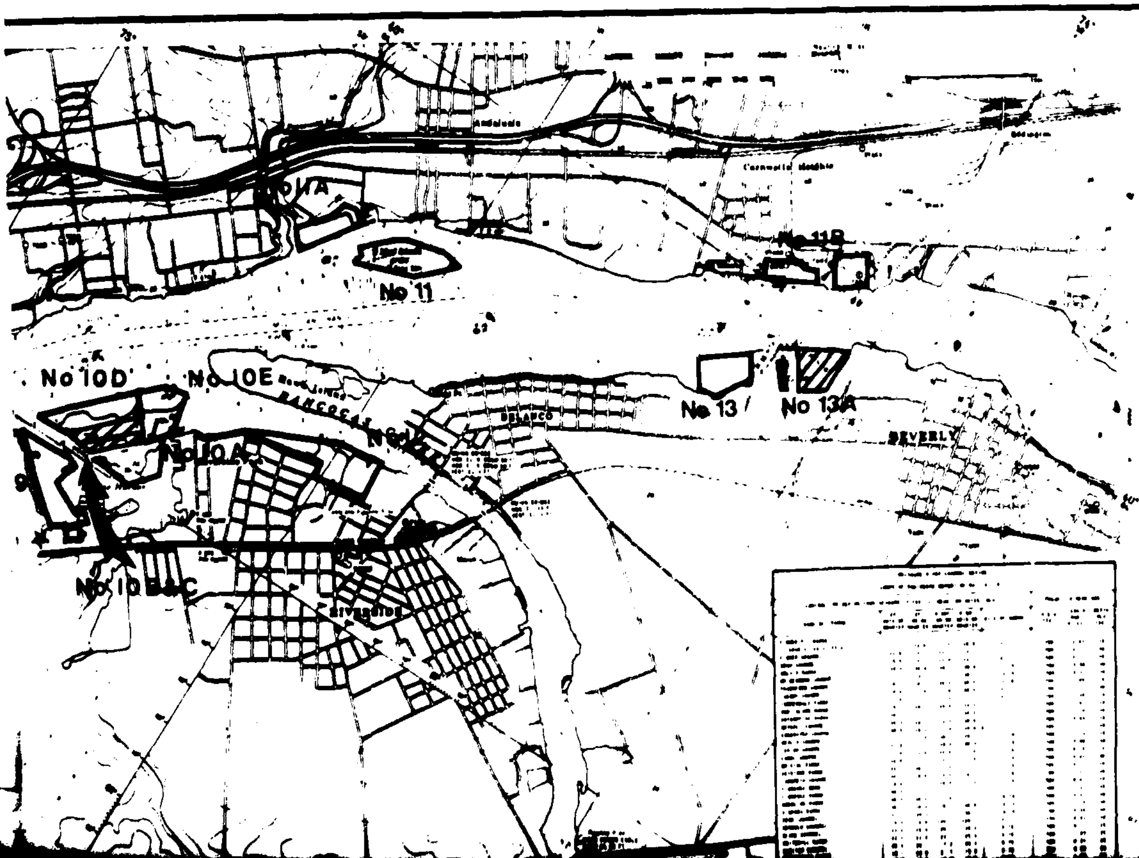


FIGURE A-25
ALTERNATE DISPOSAL AREAS
DELAWARE RIVER
PHILADELPHIA TO TRENTON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No 10A
No 10B&C
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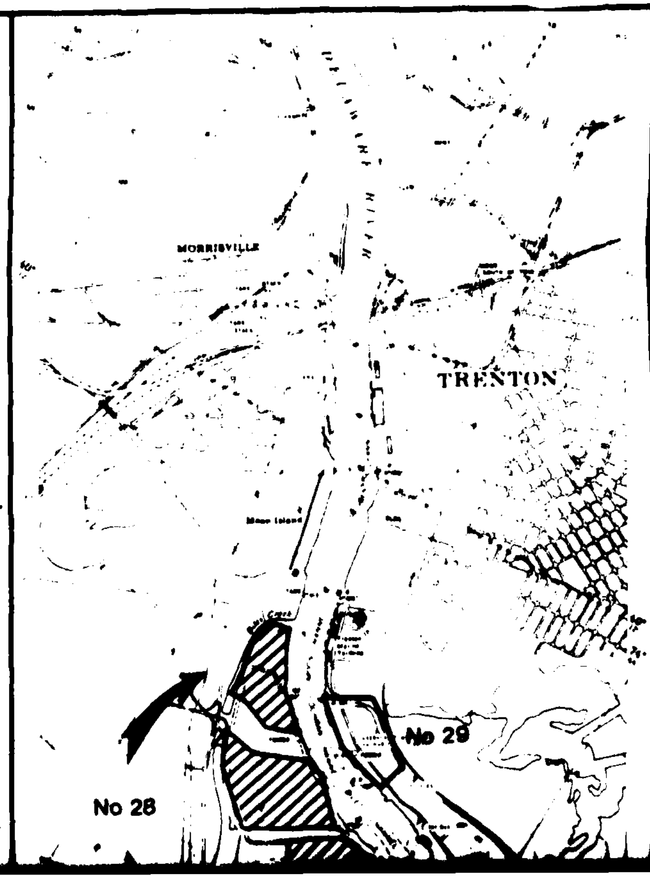
No 11B
No 13
No 13A
RANCOCAS
BEVERLY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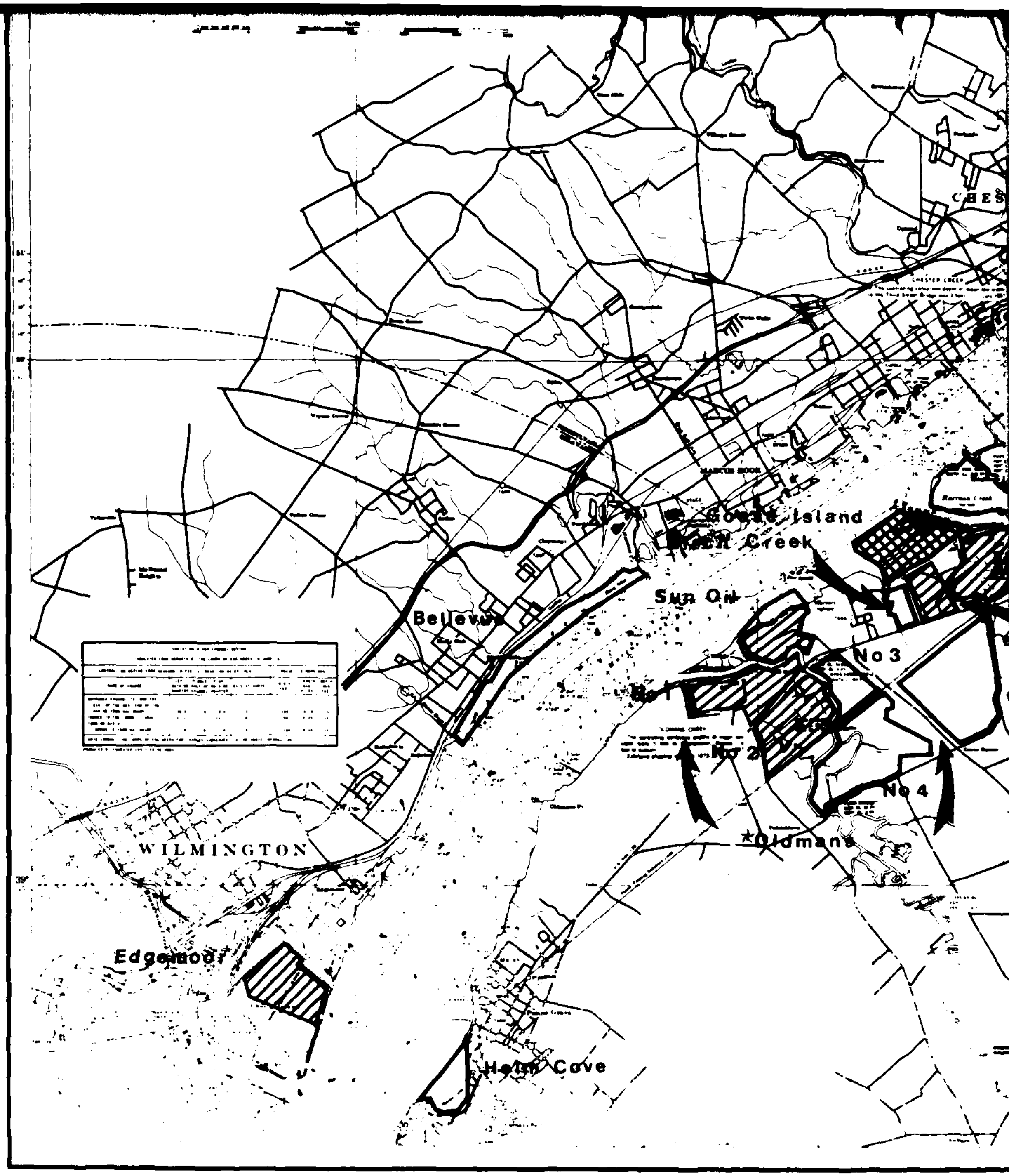
TRENTON
No 28
No 29

4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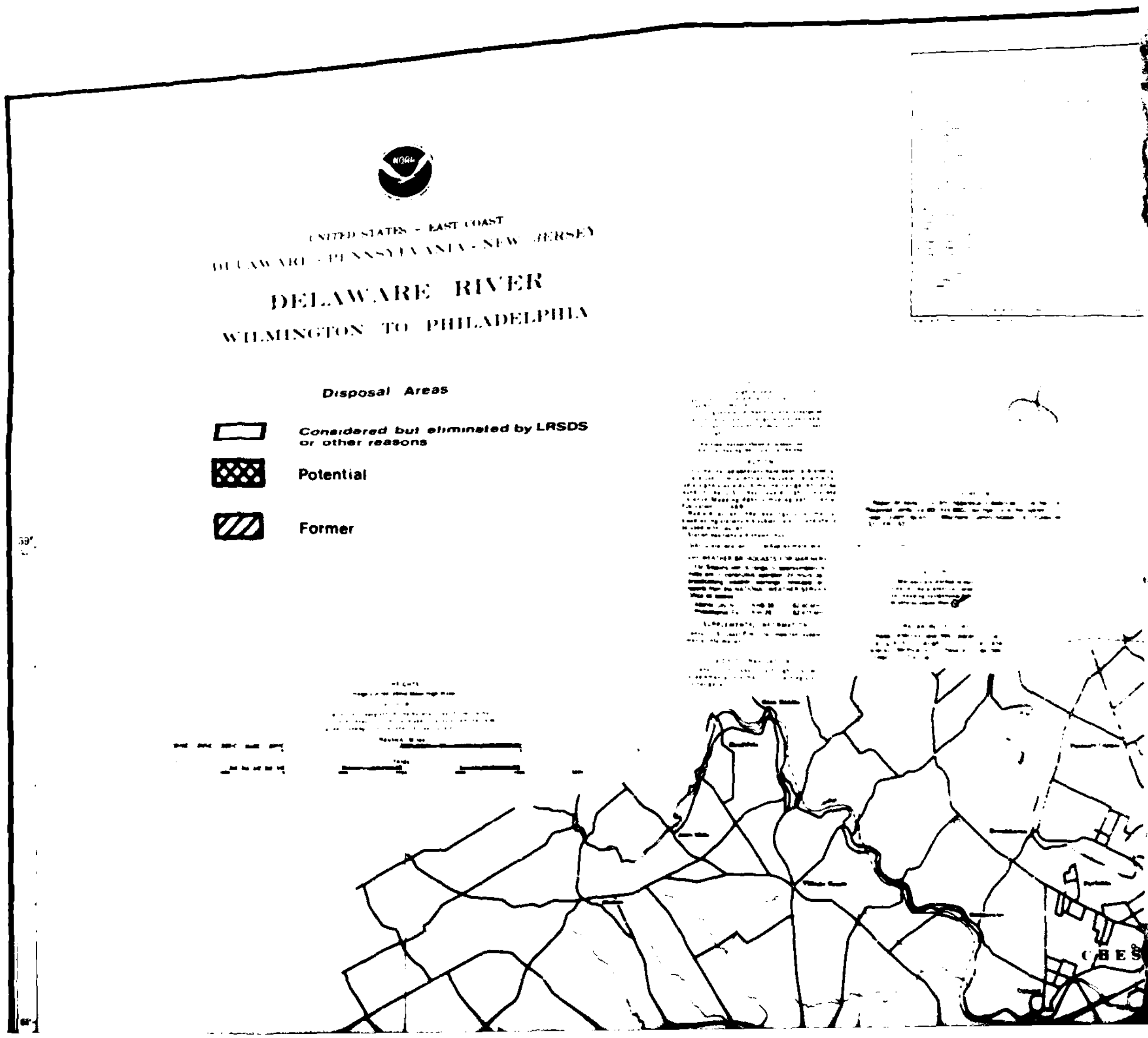
Bellevue
Sun Oil
Island
Creek
No 1
No 2
No 3
No 4
Oldmans
Cove
CHES


UNITED STATES - EAST COAST
DELAWARE - PENNSYLVANIA - NEW JERSEY
DELAWARE RIVER
WILMINGTON TO PHILADELPHIA
Disposal Areas
Considered but eliminated by LRSDS or other reasons
Potential
Former

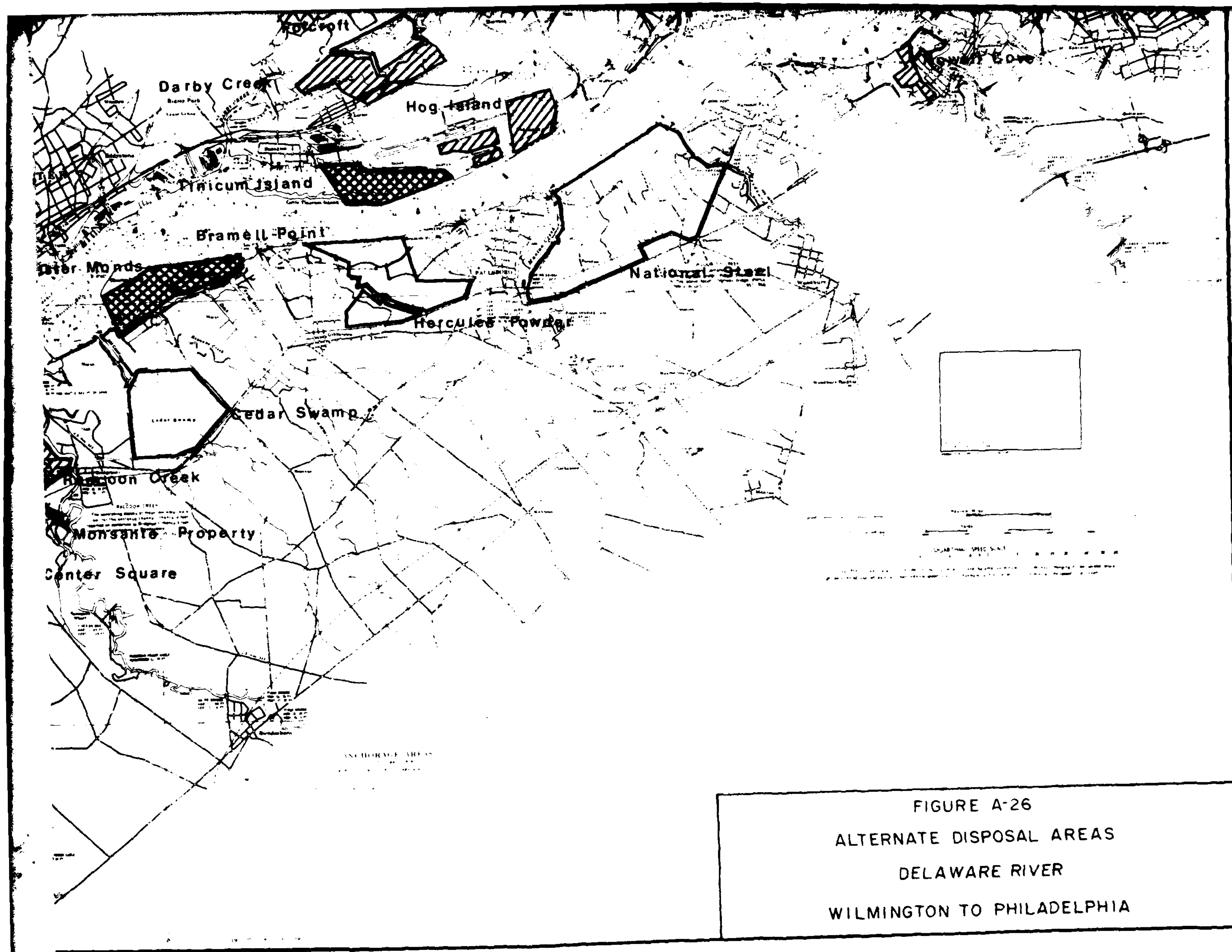
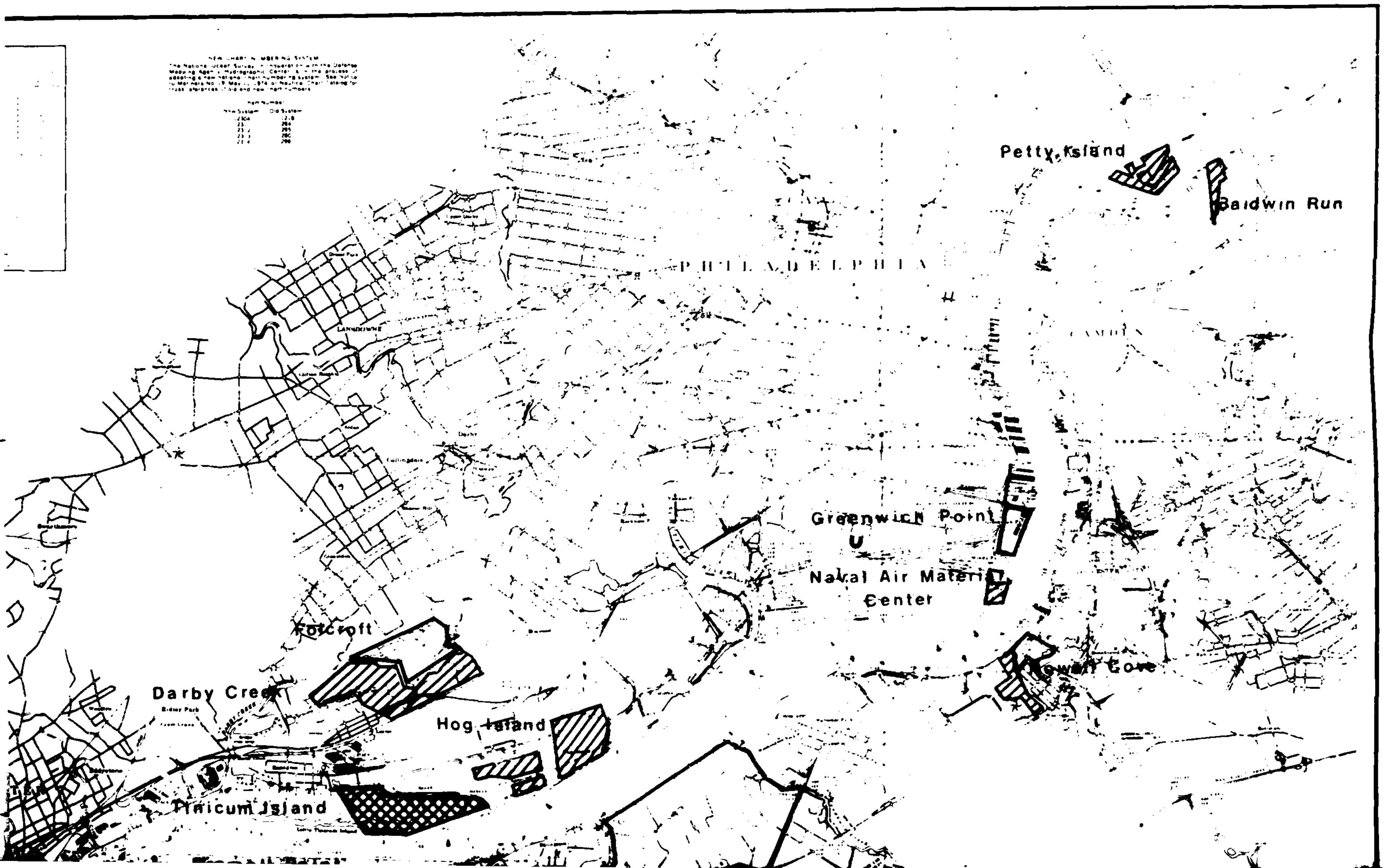
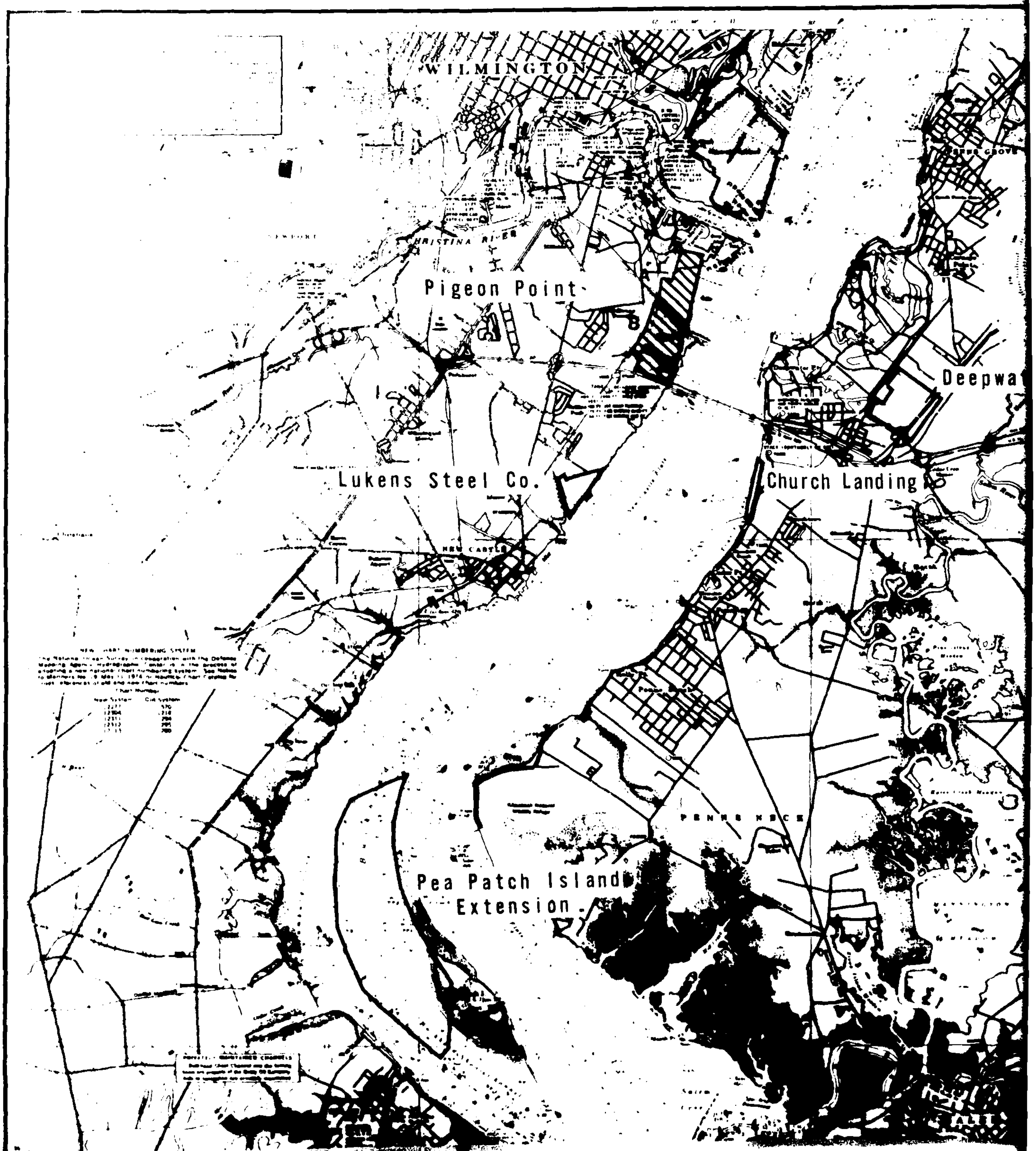
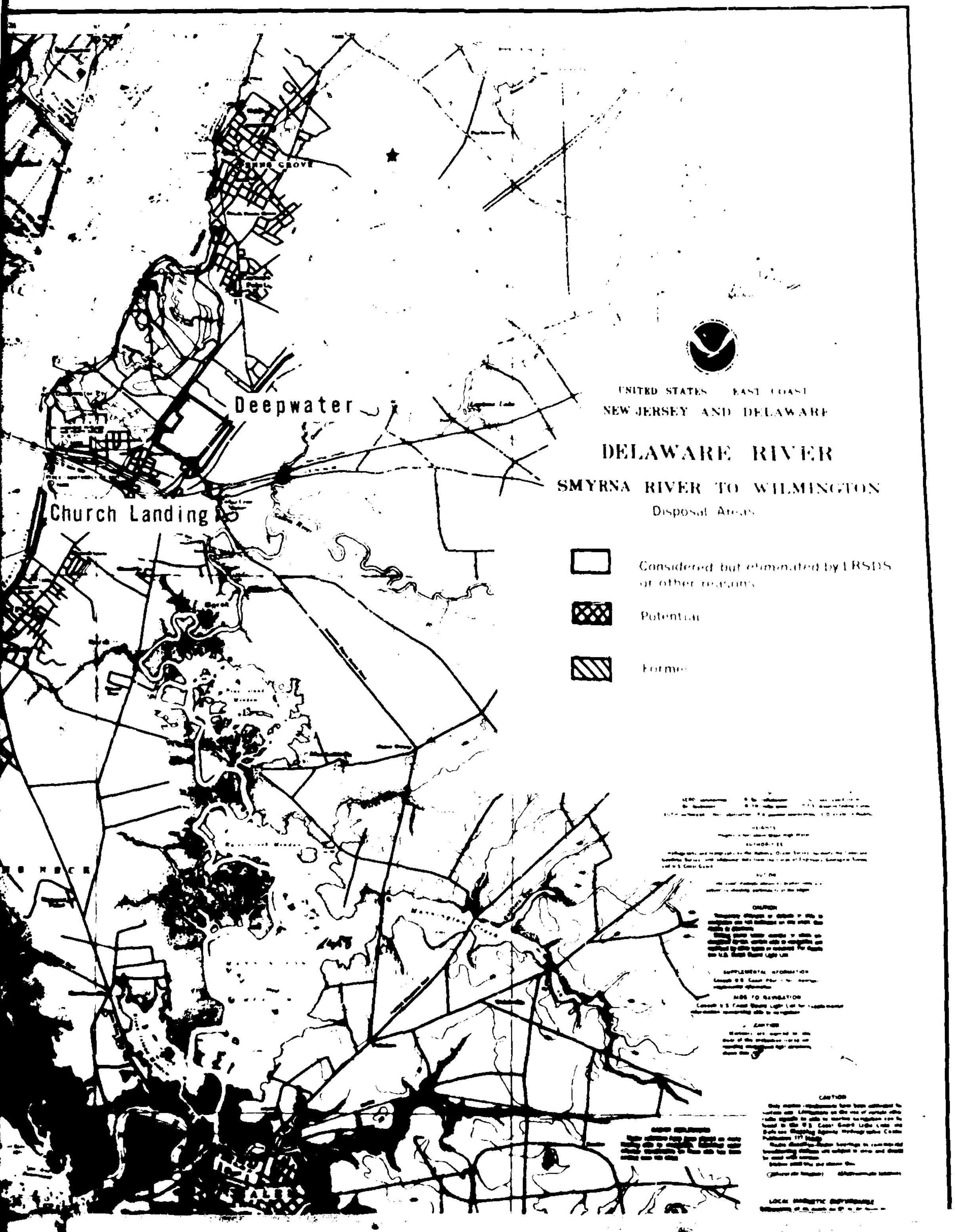


FIGURE A-26
ALTERNATE DISPOSAL AREAS
DELAWARE RIVER
WILMINGTON TO PHILADELPHIA


Petty Island
Baldwin Run
PHILADELPHIA
Greenwich Point
Naval Air Material Center
Folcroft
Darby Creek
Hog Island
Newton Cove
Tinicum Island


WILMINGTON
CHRISTINA RIVER
Pigeon Point
Deepwa
Lukens Steel Co.
Church Landing
NEW CASTLE
PENNS NECK
Pea Patch Island
Extension



Deepwater
Church Landing
UNITED STATES EAST COAST
NEW JERSEY AND DELAWARE
DELAWARE RIVER
SMYRNA RIVER TO WILMINGTON
Disposal Areas
Considered but eliminated by LRSDS or other reasons
Potential
Former
CAUTION
LOCAL MAGNETIC DISTURBANCE

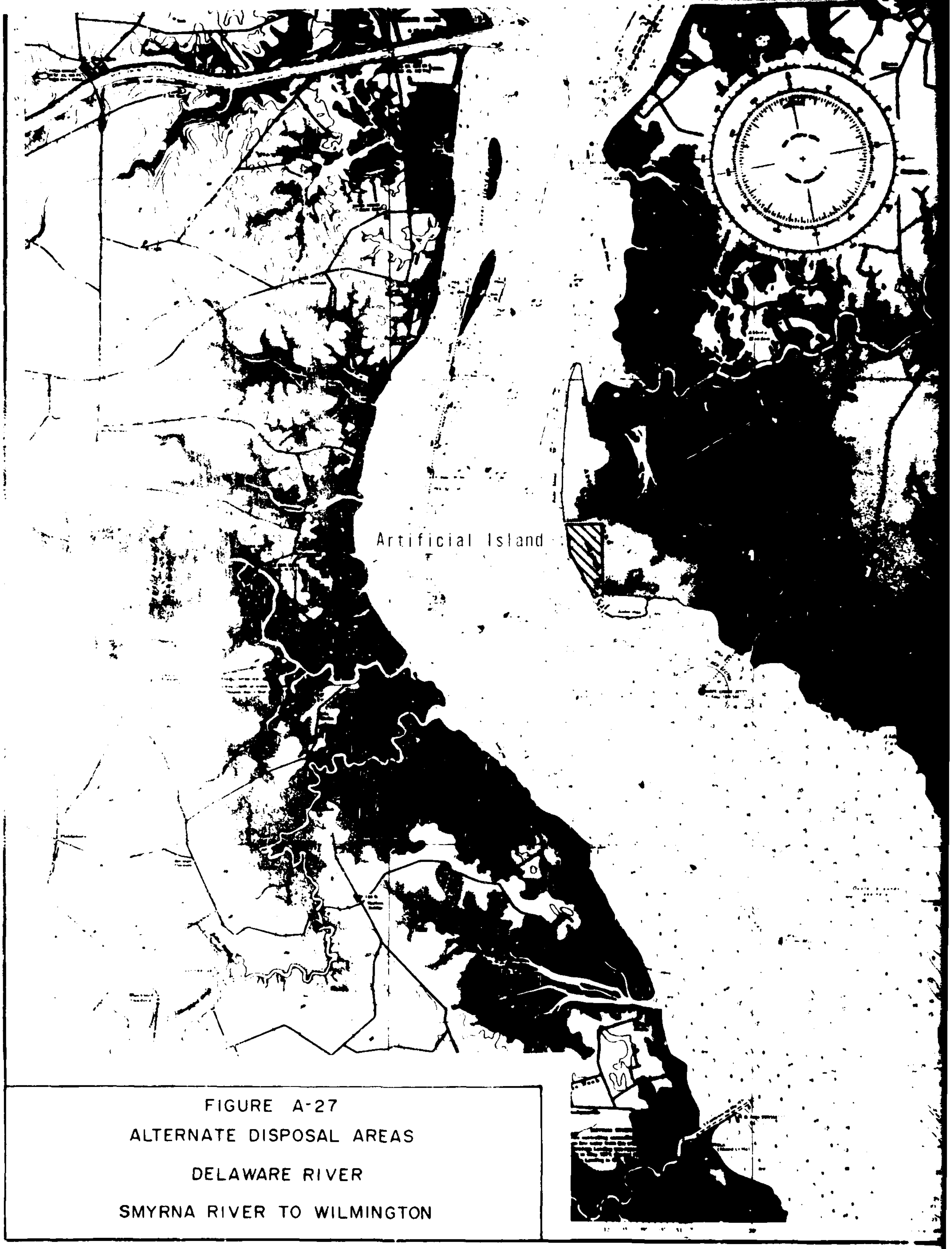
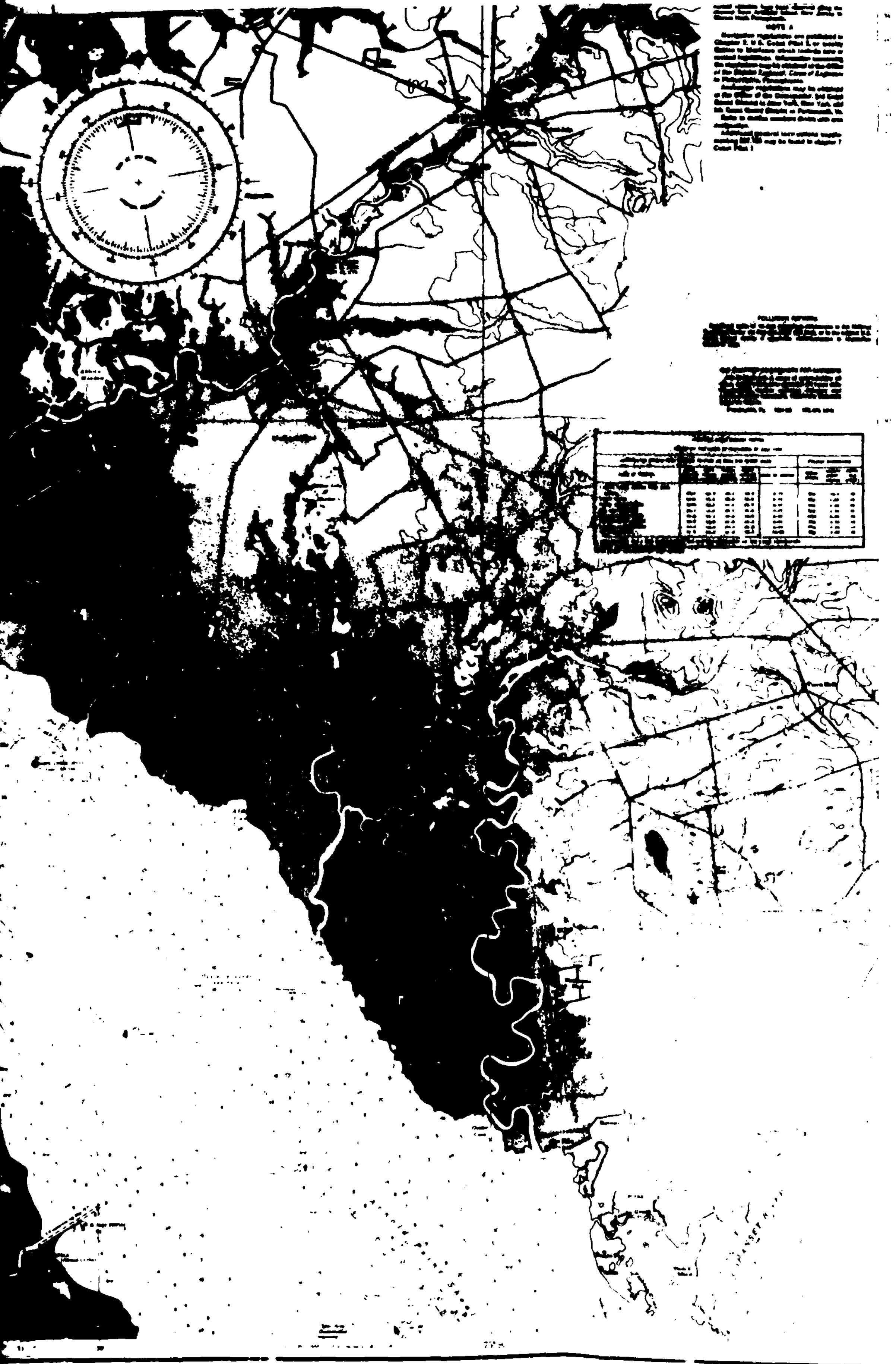


FIGURE A-27
ALTERNATE DISPOSAL AREAS
DELAWARE RIVER
SMYRNA RIVER TO WILMINGTON


NOTE A

III. IMPACT OF ENVIRONMENTAL AWARENESS POLICIES ON ATTAINING SITES

The following are brief discussions on how some of the policies identified in the Institutional Analysis Appendix, have impacted Philadelphia District procedures.

A. Fish and Wildlife Coordination Act of 1958

The impact of the Act has been the consideration of the desires of the U. S. Fish and Wildlife Service in the selection process for disposal areas. This is to assure the selection of disposal areas least objectionable to all concerned. The result has been the elimination of many potentially desirable disposal areas due to their high value to fish and wildlife.

As a result of this and other associated Federal acts the consideration and use of shallow aquatic areas of the Delaware River and its tributaries and vegetated wetlands has virtually been eliminated. The increased awareness of the value of the shallow water hatbitat and the desire to restore anadromous fish spawning runs in the Delaware River (in conjunction with improved water quality) have eliminated filling along the shoreline. The act has also been a significant factor in the failure to develop such proposals as the Chester-Monds Disposal area.

It should be pointed out that the role and jurisdiction of the U. S. Fish and Wildlife Service and the National Marine Fisheries Service and hence the impact of the Fish and Wildlife Coordination Act has increased throughout the years with the implementation of new laws and the expansion of Federal review of projects to cover all waters of the United States including adjacent wetlands.

B. National Environmental Policy Act of 1969

Continued use of existing upland disposal sites required the preparation of a composite environmental impact statement (EIS) for the navigation projects along the Delaware River and tributaries. Approximately two years were needed to prepare the report utilizing existing data. Conflicts on continued use were relatively easily resolved. The composite EIS also listed three potential disposal sites, Goose Island, Chester-Monds Island and Tinicum Island. The Environmental Protection Agency, the Department of Interior and the Department of Commerce indicated in their comments that the sighting of new disposal areas would be reviewed judiciously and would require in-depth site specific data prior to giving a view in their compatability. These agencies state that alternatives such as disposal material reuse and consolidation would have to be evaluated in detail before review of a new disposal site could even begin. Since EPA can block the

designation of sites as disposal areas, it appears that the alternative review cannot be bypassed.

C. The Federal Water Pollution Control Act (PL 92-500)

There has been no experience to date with new disposal areas within this District. However, the experience of other districts (Baltimore re: Hart-Miller disposal area especially) indicate that any opposition to a project could cause delays and project modification.

D. Clean Water Act of 1977 (PL 95-217)

Some clarification is still needed concerning this Act, but the main impact is the requirement for a state water quality permit for each disposal site. There is also the possible requirement for a discharge permit from the state. As a result we will possibly be required to do in-depth studies of water quality at existing disposal areas during use. Depending on the final nature of program guidelines the impact could be an added financial burden and time delay on O & M dredging.

E. The Marine Protection Research and Sanctuaries Act of 1972

There is no experience in this District with this Act. However, such future activity would require the issuance of a Corps permit with EPA capable of denying the use of the site.

F. Coastal Zone Management Act of 1972 (PL 92-583)

Of the three states in the study area, only New Jersey has had CZM plans approved, but even they are not completed. New Jersey's second segment of its CZM plan awaits approval along with the final plans from Delaware and Pennsylvania. Until actual implementation, the full impact will not be felt. However, the Coastal Zone Management Act of 1972 requires Federal consistency with the State plans for Corps development activities. licenses and permits, and assistance programs. "Federal Consistency with Approved CZM Plans" implementation policies and procedures have been published in the Federal Register, Monday, March 13, 1978, Part III, by the Department of Commerce.

G. Protection of Wetlands, Executive Order No. 11990

Coupled with the 404 guidelines and the Fish and Wildlife Coordination Act, the Executive Order all but eliminates use of anything but a very small marsh fringe within a disposal area. Corps could be required to provide protective surrounding dikes for marsh area and special drainage emphasis which could raise construction costs and reduce disposal capacity.

As an additional item, Section 150 of the Water Resources Development Act of 1976 authorized the Chief of Engineers to plan and establish wetland areas as part of an authorized water resources dedevelopment projects under his jurisdiction. The costs for such wetlands is not to exceed $400,000 and the benefits are assumed to at least equal the costs. All future water resource development project reports are to include consideration of the establishment of wetlands.

H. Floodplain Management, Executive Order No. 11988

The impact in the Delaware River floodplain would be to avoid developmental or enhancement type filling projects. Therefore, the land enhancement feature of spoil disposal sites in floodplains could be eliminated.

IV. IMPACT OF OTHER POLICIES

A. Local Cooperation Requirements

New Jersey and Delaware have been informed of the Corps of Engineers policy, EC 1130-2-161, concerning local cooperation requirements for all projects located within each State. In addition, Pennsylvania has been informed of this requirement concerning the Delaware River, Philadelphia to Trenton project. At this time it is not possible to assess the full impact of this new policy. The response received from Pennsylvania stated that the State will continue to provide spoil disposal sites as they have been done in the past, but will not pay any cost for preparation of the disposal areas. A similar response was received from the State of New Jersey. In return, the Corps stated that no dredging will be performed in the Delaware River, Philadelphia to Trenton, until the matter is resolved.

The following have local cooperation requirements concerning disposal areas:

- Delaware River, Philadelphia to Trenton - locals must furnish spoil disposal areas, however Federal responsibility for costs of disposal site preparation, has been cited.

- Neshaminy State Park Marina, Pa. - preparation of disposal areas a local responsibility,

- Pepper Creek, Del. - preparation of disposal areas a local responsibility.

(The remaining projects all have the local interests providing suitable spoil disposal areas with no intent for Federal costs apparent).

- Mantua Creek, NJ
- Big Timber Creek, NJ
- Mispillion River, Del.
- Little River, Del.
- Cohansey River, NJ
- Inland Waterway, Rehoboth Bay to Delaware Bay, Del.
- Waterway from Indian River Inlet to Rehoboth Bay, Del.
- Indian River Inlet and Bay, Del.

V. RESOLUTION

A. Backup

1. Recognizing the spoil disposal problem the Delaware River Basin Commission adopted Resolution No. 74-8, on 26 June 1974. This resolution requested that the Corps of Engineers expedite its continuing authorized navigation studies and that its initial efforts be directed toward:

a. The development of a dredging spoil disposal plan for the tidal Delaware River, its tidal tributaries and Delaware Bay; and

b. Designation of specific sites which may be used, with minimum degradation of the natural environment, by both the public and private sectors for the disposal of dredging spoil during the next ten years and the identification of potential sites which may be used for this purpose thereafter. This was to include an appraisal of the environmental impacts of utilizing dry, marsh and submerged sites for spoil disposal. During the course of preparing this plan the Corps of Engineers was requested to draw upon the services of and consult with other Federal and state agencies having responsibilities for environmental protection of the Delaware Estuary and Bay. Copies of this resolution were made available to the Chief of Engineers, the Secretary of the Army and the Congressional delegates of the Delaware River Basin.

2. Following the passage of this resolution, Senators William V. Roth, Jr. and Joseph R. Biden, Jr. of Delaware requested that the Senate Committee on Public Works consider the problem. Accordingly, on 20 September 1974 a resolution concerning a study to develop a regional dredging spoil disposal plan for the tidal Delaware River, its tidal tributaries and Delaware Bay was adopted by the Senate Committee on Public Works. In addition, on 24 July 1978 the Senate Committee on the Environment and Public Works increased the scope of the study to include Indian River Inlet and Bay.

B. RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE, "That the Board of Engineers for Rivers and Harbors, created under the provisions of Section 3 of the River and Harbor Act approved June 13, 1902, be, and is hereby requested to review the report of the Chief of Engineers on the Delaware River between Philadelphia, Pennsylvania, and Trenton, New Jersey, and Philadelphia to the Sea, printed as House Document 358, 83rd Congress, 2nd Session, and other reports with a view to developing a regional dredging spoil disposal plan for the tidal Delaware River, its tidal tributaries, and Delaware Bay."

NO. 74-8

A RESOLUTION with regard to a dredging spoil disposal plan.

WHEREAS, the economic welfare of the Delaware Valley is dependent upon the maintenance of its deepwater navigation facilities; and

WHEREAS, to maintain navigation in the tidal Delaware River and its tributaries requires an average annual removal and disposal of nearly 1[illegible],000,000 cubic yards of material; and

WHEREAS, it is necessary to appraise the environmental consequences of utilizing either dry, marsh, or submerged lands at sites for disposal of dredging spoil; and

WHEREAS, the ever-increasing competition for land among agricultural, industrial, environmental and navigational concerns mandates an early resolution to these potential conflicts; and

WHEREAS, the U. S. Army Corps of Engineers has been authorized by Congressional resolution to study the feasibility of modifying the channel dimensions of the Delaware River and developing a regional port system for the Delaware Valley; and

WHEREAS, the U. S. Army Corps of Engineers and other agencies in the course of previous studies have amassed substantial data relating to the problems of spoil disposal which can form the basis of a sound regional site disposal plan; now therefore

BE IT RESOLVED by the Delaware River Basin Commission:

1. The U. S. Army Corps of Engineers, Philadelphia District, is requested to expedite its continuing authorized navigation studies and that its initial efforts be directed toward:

(a) The development of a dredging spoil disposal plan for the tidal Delaware River, its tidal tributaries and Delaware Bay; and

(b) Designation of specific sites which may be used, with minimum degradation of the natural environment, by both the public and private sectors for the disposal of dredging spoil during the next ten years and the identification of potential sites which may be used for this purpose thereafter.

2. During the course of preparing a dredging spoil disposal plan the U. S. Army Corps of Engineers is further requested to draw upon the services of and consult with other federal and state agencies having responsibilities for environmental protection of the Delaware Estuary and Bay.

3. Copies of this Resolution shall be made available to the Chief of Engineers, the Secretary of the Army and the Congressional delegates of the Delaware River Basin.

Chairman

ADOPTED: June 26, 1974

Secretary

93rd Congress

2nd Session

United States Senate

COMMITTEE ON PUBLIC WORKS

COMMITTEE RESOLUTION

RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE,

That the Board of Engineers for Rivers and Harbors, created under the provisions of Section 3 of the River and Harbor Act approved June 13, 1902, be, and is hereby requested to review the report of the Chief of Engineers on the Delaware River between Philadelphia, Pennsylvania, and Trenton, New Jersey, and Philadelphia to the Sea, printed as House Document 358, 83rd Congress, 2nd Session, and other reports with a view to developing a regional dredging spoil disposal plan for the tidal Delaware River, its tidal tributaries, and Delaware Bay.

Adopted: September 20, 1974

Jennings Randolph, Chairman.

(At the request of William Roth and Joseph Biden, Senators from Delaware)

95th Congress

2nd Session

United States Senate

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

COMMITTEE RESOLUTION

RESOLVED BY THE COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS OF THE UNITED STATES SENATE, That the Board of Engineers for Rivers and Harbors, created under the provision of Section 3 of the River and Harbor Act approved June 13, 1902, be, and is hereby requested to review the report of the Chief of Engineers on the Delaware River between Philadelphia, Pennsylvania, and Trenton, New Jersey, and Philadelphia to the Sea, printed as House Document No. 330, Seventy-sixth Congress, and other reports with a view to developing a regional dredging spoil disposal plan for the tidal Delaware River, its tidal tributaries, and Delaware Bay, and Indian River Inlet and Bay.

Jennings Randolph

Jennings Randolph, CHAIRMAN

Robert T. Stafford, RANKING MINORITY MEMBER

Adopted: July 24, 1978

GPO 88-117-6

(At the request of Senator William V. Roth, Jr., from Delaware)

APPENDIX B

PUBLIC VIEWS AND RESPONSES

APPENDIX B

PUBLIC VIEWS AND RESPONSES

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Table of Contents (Con't.)

Table of Contents (Con't.)

MAILING LIST

INTERESTED PARTY LIST 02/24/78
U. S. SENATORS

DELAWARE

HON. JOSEPH R. BIDEN, JR.
UNITED STATES SENATOR
SENATE OFFICE BLDG.
WASHINGTON, DC 20510

HON. JOSEPH R. BIDEN, JR.
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FEDERAL BUILDING
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WILMINGTON, DE. 19801

HON. JOSEPH R. BIDEN, JR.
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ATTN: MR. VINCENT D'ANNA

HON. WILLIAM V. ROTH, JR.
UNITED STATES SENATOR
SENATE OFFICE BUILDING
WASHINGTON, DC. 20510

HON. WILLIAM V. ROTH JR.
UNITED STATES SENATOR
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HON. CLIFFORD P. CASE
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SENATE OFFICE BLDG.
WASHINGTON, DC 20510

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MOORESTOWN, NJ 08057

HON. JAMES J FLORIO
MEMBER OF CONGRESS
HOUSE OFFICE BLDG.
WASHINGTON, DC 20510

HON. WILLIAM J.HUGHES
MEMBER OF CONGRESS
HOUSE OFC. BLDG.
WASHINGTON, D.C. 20510

PENNSYLVANIA

HON. ROBERT N. NIX
U.S. HOUSE OF REPRESENTATIVES
HOUSE OFFICE BLDG.
WASHINGTON, DC. 20515

HON. RAYMOND F. LEDERER
U.S. HOUSE OF REPRESENTATIVES
HOUSE OFFICE BLDG.
WASHINGTON, DC. 20515

PENNSYLVANIA

HON. RICHARD T. SCHULZE
U.S. HOUSE OF REPRESENTATIVES
HOUSE OFFICE BLDG.
WASHINGTON, DC. 20515

HON. ROBERT W. EDGAR
U.S. HOUSE OF REPRESENTATIVES
HOUSE OFFICE BLDG.
WASHINGTON, DC. 20515

STATE GOVERNOR

DELAWARE

HON. PIERRE S. DU PONT IV
GOVERNOR
STATE OF DELAWARE
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

NEW JERSEY

HON. BRENDAN T. BYRNE
GOVERNOR OF NEW JERSEY
STATE CAPITAL
TRENTON, NJ 08625

PENNSYLVANIA

HON. MILTON J. SHAPP
GOVERNOR
STATE OF PENNSYLVANIA
MAIN CAPITOL BUILDING
HARRISBURG, PA 17120

STATE LEGISLATURE

DELAWARE STATE SENATE

DELAWARE STATE SENATE

HON. HARRIS B. MC DOWELL III
DELAWARE SENATE
1ST DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER,DE 19901

HON. HERMAN M. HOLLOWAY, SR.
DELAWARE SENATE
2ND DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER,DE 19901

HON. GEORGE F. SCHLUR
DELAWARE SENATE
3RD DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER,DE 19901

HON. ROBERT J. BERNDT
DELAWARE SENATE
4TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER,DE 19901

HON. CHARLES E. HUGHES
DELAWARE SENATE
5TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER,DE 19901

HON. DANIEL E. WEISS
DELAWARE SENATE
6TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER,DE 19901

HON. ANDREW G. KNOX
DELAWARE SENATE
7TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER,DE 19901

HON. JOHN M. ARNOLD
DELAWARE SENATE
8TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER,DE 19901

HON. THOMAS B. SHARP
DELAWARE SENATE
9TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER,DE 19901

HON. EVERETTE HALE
DELAWARE SENATE
10TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER,DE 19901

DELAWARE STATE SENATE

HON. ANTHONY J. CICIONE
DELAWARE SENATE
11TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER,DE 19901

HON. FRANCIS KEARNS
DELAWARE SENATE
13TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER,DE 19901

HON. ALFRED H. SPENCE
DELAWARE SENATE
15TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER,DE 19901

HON. JACOB W. ZIMMERMAN
DELAWARE SENATE
17TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER,DE 19901

HON. THURMAN ADAMS, JR.
DELAWARE SENATE
19TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER,DE 19901

HON. CALVIN R. MC CULLOUGH
DELAWARE SENATE
12TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER,DE 19901

HON. ROGER MARTIN
DELAWARE SENATE
14TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER,DE 19901

HON. NANCY COOK
DELAWARE SENATE
16TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER,DE 19901

HON. WILLIAM M. MURPHY
DELAWARE SENATE
18TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER,DE 19901

HON. RICHARD CORDREY
DELAWARE SENATE
20TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER,DE 19901

DELAWARE STATE HOUSE OF REPRESENTATIVES

HON. LEE LITTLETON
DELAWARE SENATE
21ST DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER,DE 19901

DELAWARE STATE HOUSE OF REPRESENTATIVES

HON. ORLANDO J. GEORGE, JR.
DEL. HOUSE OF REPRESENTATIVES
1ST DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. AL O. PLANT
DEL. HOUSE OF REPRESENTATIVES
2ND DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. MRS. HENRIETTA JOHNSON
DEL. HOUSE OF REPRESENTATIVES
3RD DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. MARCELLO RISPOLI
DEL. HOUSE OF REPRESENTATIVES
4TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. CASMIR S. JONKIERT
DEL. HOUSE OF REPRESENTATIVES
5TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. THOS. E. BRADY
DEL. HOUSE OF REPRESENTATIVES
6TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. JOSEPH AMBROSINO
DEL. HOUSE OF REPRESENTATIVES
7TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. JOSEPH C. LOUGHNEY
DEL. HOUSE OF REPRESENTATIVES
8TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

DELAWARE STATE HOUSE OF REPRESENTATIVES

HON. CHARLES L. HEBNER
DEL. HOUSE OF REPRESENTATIVES
9TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. GWYNNE P. SMITH
DEL. HOUSE OF REPRESENTATIVES
10TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. RICHARD SINCOCK
DEL. HOUSE OF REPRESENTATIVES
11TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. C. LESLIE RIDINGS, JR.
DEL. HOUSE OF REPRESENTATIVES
12TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. JOHN P. MCKAY
DEL. HOUSE OF REPRESENTATIVES
13TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. ROBERT L. MAXWELL
DEL. HOUSE OF REPRESENTATIVES
14TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. ROBERT L. BYRD
DEL. HOUSE OF REPRESENTATIVES
15TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. DANIEL A. KELLY
DEL. HOUSE OF REPRESENTATIVES
16TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. JOHN MATUSHEFSKE
DEL. HOUSE OF REPRESENTATIVES
17TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. KENNETH BOULDEN
DEL. HOUSE OF REPRESENTATIVES
18TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

DELAWARE STATE HOUSE OF REPRESENTATIVES

HON. ROBERT T. CONNER
DEL. HOUSE OF REPRESENTATIVES
19TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. JOHN P. FERGUSON
DEL. HOUSE OF REPRESENTATIVES
20TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. ROBERT GILLIGAN
DEL. HOUSE OF REPRESENTATIVES
21ST DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. ROGER P. ROY
DEL. HOUSE OF REPRESENTATIVES
22ND DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. ROBERT S. POWELL
DEL. HOUSE OF REPRESENTATIVES
23RD DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. WILLIAM A. OBERLE, JR.
DEL. HOUSE OF REPRESENTATIVES
24TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. JOHN G. S. BILLINGSLEY
DEL. HOUSE OF REPRESENTATIVES
25TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. MARIAN P. ANDERSON
DEL. HOUSE OF REPRESENTATIVES
26TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. MRS. SANDRA D. WORTHEN
DEL. HOUSE OF REPRESENTATIVES
27TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. GERARD A. CAIN
DEL. HOUSE OF REPRESENTATIVES
28TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

DELAWARE STATE HOUSE OF REPRESENTATIVES

HON. WILLIAM M. BRADY II
DEL. HOUSE OF REPRESENTATIVES
29TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. ROBT. W. RIDDAUGH
DEL. HOUSE OF REPRESENTATIVES
30TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. KAREN JENNINGS MILLER
DEL. HOUSE OF REPRESENTATIVES
31ST DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. EDWARD J. BENNETT
DEL. HOUSE OF REPRESENTATIVES
32ND DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. RUTH A. MINNER
DEL. HOUSE OF REPRESENTATIVES
33RD DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. JOHN E. MORRIS
DEL. HOUSE OF REPRESENTATIVES
34TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. RONALD DARLING
DEL. HOUSE OF REPRESENTATIVES
35TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. JOHN M. BURRIS
DEL. HOUSE OF REPRESENTATIVES
36TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. WILLIAM M. VERNON
DEL. HOUSE OF REPRESENTATIVES
37TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. HOWARD A. CLENDANIEL
DEL. HOUSE OF REPRESENTATIVES
38TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

DELAWARE STATE HOUSE OF REPRESENTATIVES

HON. THOMAS A. TEMPLE, SR.
DEL. HOUSE OF REPRESENTATIVES
39TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. WILLIAM J. GORDY
DEL. HOUSE OF REPRESENTATIVES
40TH DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

HON. DONALD J. LYNCH
DEL. HOUSE OF
41ST DISTRICT
LEGISLATIVE HALL
STATE CAPITAL
DOVER, DE. 19901

NEW JERSEY STATE SENATE

HON. JAS. S. CAFIERO
NEW JERSEY SENATE
1ST DISTRICT
STATE CAPITAL
TRENTON, N.J. 08625

HON. DR. JOS. L. MC GAHN
NEW JERSEY SENATE
2ND DISTRICT
STATE CAPITAL
TRENTON, N.J. 08625

HON. RAYMOND J. ZANE
NEW JERSEY SENATE
3RD DISTRICT
STATE CAPITAL
TRENTON, NJ 08625

HON. JOSEPH A. MARESSA
NEW JERSEY SENATE
4TH DISTRICT
STATE CAPITAL
TRENTON, NJ. 08625

HON. JOHN J. HORN
NEW JERSEY SENATE
5TH DISTRICT
STATE CAPITAL
TRENTON, NJ. 08625

HON. ALENE S. AMMOND
NEW JERSEY SENATE
6TH DISTRICT
STATE CAPITAL
TRENTON, NJ. 08625

NEW JERSEY STATE SENATE

HON. EDWARD J. HUGHES
NEW JERSEY SENATE
7TH DISTRICT
STATE CAPITAL
TRENTON, NJ. 08625

HON. BARRY T. PARKER
NEW JERSEY SENATE
8TH DISTRICT
STATE CAPITAL
TRENTON, NJ. 08625

HON. JOHN F. RUSSO
NEW JERSEY SENATE
9TH DISTRICT
STATE CAPITAL
TRENTON, NJ. 08625

NEW JERSEY STATE GENERAL ASSEMBLY

HON. JAS. R. HURLEY
N.J. GENERAL ASSEMBLY
1ST DISTRICT
STATE CAPITAL
TRENTON, N.J. 08625

HON. HOWARD KUPPERMAN
N.J. GENERAL ASSEMBLY
2ND DISTRICT
STATE CAPITAL
TRENTON, NJ 08625

HON. STEVE P. PERSKIE
N.J. GENERAL ASSEMBLY
2ND DISTRICT
STATE CAPITAL
TRENTON, N.J. 08625

HON. H. DONALD STEWART
N.J. GENERAL ASSEMBLY
3RD DISTRICT
STATE CAPITAL
TRENTON, NJ 08625

HON. MARTIN A. HERMAN
N.J. GENERAL ASSEMBLY
3RD DISTRICT
STATE CAPITAL
TRENTON, NJ 08625

HON. KENNETH A. GEWERTZ
N.J. GENERAL ASSEMBLY
4TH DISTRICT
STATE CAPITAL
TRENTON, NJ 08625

HON. FRANCIS J. GORMAN
N.J. GENERAL ASSEMBLY
4TH DISTRICT
STATE CAPITAL
TRENTON, N.J. 08625

HON. FRANCIS J. GORMAN
N.J. GENERAL ASSEMBLY
5TH DISTRICT
STATE CAPITAL
TRENTON, N.J. 08625

NEW JERSEY STATE GENERAL ASSEMBLY

HON. ERNEST F. SCHUCK
N.J. GENERAL ASSEMBLY
5TH DISTRICT
STATE CAPITAL
TRENTON, N.J. 08625

HON. MRS. MARY KEATING CROCE
N.J. GENERAL ASSEMBLY
6TH DISTRICT
STATE CAPITAL
TRENTON, NJ 08625

HON. JOHN J. GALLAGHER, JR.
N.J. GENERAL ASSEMBLY
6TH DISTRICT
STATE CAPITAL
TRENTON, N.J. 08625

HON. GEORGE H. BARBOUR
N.J. GENERAL ASSEMBLY
7TH DISTRICT
STATE CAPITAL
TRENTON, NJ. 08625

HON. CHARLES B. YATES
N.J. GENERAL ASSEMBLY
7TH DISTRICT
STATE CAPITAL
TRENTON, NJ. 08625

HON. CLIFFORD W. SNEDEKER
N.J. GENERAL ASSEMBLY
8TH DISTRICT
STATE CAPITAL
TRENTON, NJ. 08625

HON. H. JAS. SAXTON
N.J. GENERAL ASSEMBLY
8TH DISTRICT
STATE CAPITAL
TRENTON, NJ. 08625

HON. JOHN PAUL DOYLE
N.J. GENERAL ASSEMBLY
9TH DISTRICT
STATE CAPITAL
TRENTON, NJ. 08625

HON. DANIEL F. NEWMAN
N.J. GENERAL ASSEMBLY
9TH DISTRICT
STATE CAPITAL
TRENTON, NJ. 08625

PENNSYLVANIA STATE SENATE

HON. JOSEPH SMITH
PA. STATE SENATE
1ST DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. FRANCIS J. LYNCH
PA. STATE SENATE
2ND DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

PENNSYLVANIA STATE SENATE

HON. JOSEPH F. SMITH
PA. STATE SENATE
4TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. H. CRAIG LEWIS
PA. STATE SENATE
6TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. FREEMAN HANKINS
PA. STATE SENATE
7TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. PAUL MCKINNEY
PA. STATE SENATE
8TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. CLARENCE D. BELL
PA. STATE SENATE
9TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. EDWARD L. HOWARD
PA. STATE SENATE
10TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. LOUIS G. HILL
PA. STATE SENATE
36TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

PENNSYLVANIA STATE HOUSE OF REPRESENTATIVES

HON. THEODORE BERLIN
PA. STATE HOUSE OF REPRESENTATIVES
140TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. JAMES J.A. GALLAGHER
PA. STATE HOUSE OF REPRESENTATIVES
141ST DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. JAMES L. WRIGHT, JR.
PA. STATE HOUSE OF REPRESENTATIVES
142ND DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. MARGARET H. GEORGE
PA. STATE HOUSE OF REPRESENTATIVES
143RD DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

PENNSYLVANIA STATE HOUSE OF REPRESENTATIVES

HON. BENJAMIN H. WILSON
PA. STATE HOUSE OF REPRESENTATIVES
144TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. MARVIN D. WEIDNER
PA. STATE HOUSE OF REPRESENTATIVES
145TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. FRANCIS X. TENAGIO
PA. STATE HOUSE OF REPRESENTATIVES
159TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. RALPH GARCIA
PA. HOUSE OF REPRESENTATIVES
160TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. PETER O' KEEFE
PA. HOUSE OF REPRESENTATIVES
161ST DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. GERALD J. SPITZ
PA. HOUSE OF REPRESENTATIVES
162ND DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. JOSEPH T. DOYLE
PA. STATE HOUSE OF REPRESENTATIVES
163RD DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. FRANCIS J. LYNCH
PA. STATE HOUSE OF REPRESENTATIVE
164TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. THOMAS STAPLTON
PA. HOUSE OF REPRESENTATIVES
165TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. STEPHEN R. FRIEND
PA. STATE HOUSE OF REPRESENTATIVE
166TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. HERBERT K. ZEARFUSS
PA. STATE HOUSE OF REPRESENTATIVES
167TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. MATHEW J. RYAN
PA. STATE HOUSE OF REPRESENTATIVE
168TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

PENNSYLVANIA STATE HOUSE OF REPRESENTATIVES

HON. *****
PA. STATE HOUSE OF REPRESENTATIVES
169TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. FRANK A. SALVATORE
PA. STATE HOUSE OF REPRESENTATIVES
170TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. ROLAND GREENFIELD
PA. STATE HOUSE OF REPRESENTATIVES
171ST DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. FRANCIS E. GLEESON, JR.
PA. STATE HOUSE OF REPRESENTATIVES
172ND DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. HENRY J. GIAMMARCO
PA. STATE HOUSE OF REPRESENTATIVES
173RD DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. MAX PIEVSKY
PA. STATE HOUSE OF REPRESENTATIVES
174TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. ROBERT A. BORSKI
PA. STATE HOUSE OF REPRESENTATIVES
175TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. ALVIN KATZ
PA. STATE HOUSE OF REPRESENTATIVES
176TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. AGNES M. SCANLON
PA. STATE HOUSE OF REPRESENTATIVES
177TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. JAS. MC INTYRE
PA. STATE HOUSE OF REPRESENTATIVES
178TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. WILLIAM W. RIEGER
PA. STATE HOUSE OF REPRESENTATIVES
179TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. CLIFFORD GRAY
PA. STATE HOUSE OF REPRESENTATIVES
180TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

PENNSYLVANIA STATE HOUSE OF REPRESENTATIVES

HON. ULYSSES SHELTON
PA. STATE HOUSE OF REPRESENTATIVES
181ST DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. SAMUEL RAPPAPORT
PA. STATE HOUSE OF REPRESENTATIVES
182ND DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. MATTHEW J. CIANCIULLI
PA. STATE HOUSE OF REPRESENTATIVES
183RD DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. LELAND BELOFF
PA. STATE HOUSE OF REPRESENTATIVE
184TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. RONALD DONATUCCI
PA. STATE HOUSE OF REPRESENTATIVES
185TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. EDWARD WIGGINS
PA. STATE HOUSE OF REPRESENTATIVES
186TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. NORMAN S. BERSON
PA. STATE HOUSE OF REPRESENTATIVES
187TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. ALJIA DU MAS
PA. STATE HOUSE OF REPRESENTATIVES
188TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. MARTIN P. MULLEN
PA. STATE HOUSE OF REPRESENTATIVES
189TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. JAMES D. BARBER
PA. STATE HOUSE OF REPRESENTATIVE
190TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. HARDY WILLIAMS
PA. STATE HOUSE OF REPRESENTATIVES
191ST DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. ANITA P. KELLY
PA. STATE HOUSE OF REPRESENTATIVE
192ND DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

PENNSYLVANIA STATE HOUSE OF REPRESENTATIVES

HON. HERBERT FINEMAN
PA. STATE HOUSE OF REPRESENTATIVES
194TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. RUTH HARPER
PA. STATE HOUSE OF REPRESENTATIVES
196TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. ROBT. E. O'DONNELL
PA. STATE HOUSE OF REPRESENTATIVES
198TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. JOHN F. WHITE, JR.
PA. STATE HOUSE OF REPRESENTATIVES
200TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. MARK B. COHEN
PA. STATE HOUSE OF REPRESENTATIVES
202ND DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120
PHILADELPHIA, PA

HON. FRANK L. OLIVER
PA. STATE HOUSE OF REPRESENTATIVES
195TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. JOEL J. JOHNSON
PA. STATE HOUSE OF REPRESENTATIVES
197TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. JOHN H. HAMILTON, JR.
PA. STATE HOUSE OF REPRESENTATIVES
199TH DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. DAVID P. RICHARDSON
PA. STATE HOUSE OF REPRESENTATIVES
201ST DISTRICT
MAIN CAPITOL BLDG.
HARRISBURG, PA. 17120

HON. JAMES F. JONES, JR.
PA. STATE HOUSE OF REPRESENTATIVES
203RD DISTRICT
MAIN CAPITOL BLDG.
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PENNSYLVANIA COMMISSIONS

PENNSYLVANIA COMMISSIONS

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COUNTY REPRESENTATIVES

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KENT COUNTY

NEW CASTLE COUNTY

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DIRECTOR
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COUNTY CLERK
BURLINGTON COUNTY
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BURLINGTON COUNTY

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CAMDEN COUNTY

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ADMINISTRATION BUILDING
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COUNTY CLERK
BUCKS COUNTY
ADMINISTRATION BUILDING
DOYLESTOWN, PA 18901

BUCKS COUNTY

DIRECTOR
BUCKS COUNTY PLANNING COMMISSION
ADMINISTRATION BUILDING
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COUNTY PLANNER
BUCKS COUNTY
ADMINISTRATION BUILDING
DOYLESTOWN, PA 18901

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BUCKS COUNTY
SOIL & WATER CONSERVATION
COURTHOUSE
DOYLESTOWN, PA 18901

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CHAIRMAN
DELAWARE COUNTY COMMISSIONERS
COURTHOUSE
MEDIA, PA, 19063

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DELAWARE COUNTY
COURTHOUSE
MEDIA, PA, 19063

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FRONEFIELD BUILDING
214 NORTH AVENUE
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DELAWARE CO. PLANNING COMM.
COURTHOUSE
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COUNTY ENGINEER
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COUNTY SURVEYOR
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COURTHOUSE
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CAMDEN, DE 19934

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CHESWOLD, DE 19936

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TOWN OF CLAYTON
MAIN STREET
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CITY HALL
THE PLAZA
DOVER, DE 19901

CITY MANAGER
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CITY HALL
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TOWN OF FARMINGTON
FARMINGTON, DE 19942

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TOWN OF LITTLE CREEK
TOWN HALL
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LITTLE CREEK, DE 19961

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CITY OF MILFORD
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MILFORD, DE 19963

MAYOR
CITY OF SMYRNA
MAIN STREET
SMYRNA, DE 19977

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TOWN OF LEIPSIC
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CITY MANAGER
CITY OF SMYRNA
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BROAD STREET
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CLERK
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CLERK
CITY OF BORDENTOWN
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MAYOR
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MUNICIPAL DRIVE
BORDENTOWN, NJ 08505

CLERK
BORDENTOWN TOWNSHIP
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432 HIGH ST.
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CLERK
CITY OF BURLINGTON
CITY HALL
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CLERK MT. HOLLY TOWNSHIP 23 WASHINGTON ST. MT. HOLLY, NJ 08060	MAYOR MOUNT LAUREL TOWNSHIP 100 N. MOUNT LAUREL RD. P.O. BOX 1872 MOUNT LAUREL, NJ. 08054
CLERK MOUNT LAUREL TOWNSHIP 100 N. MOUNT ALUREL RD. P.O. BOX 1872 MOUNT LAUREL, NJ. 08054	MAYOR NEW HANOVER TOWNSHIP BOX 7 COOKSTOWN, NJ 08511
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CLERK PEMBERTON TOWNSHIP P.O. BOX 175 NEW LISBON, NJ 08064	MAYOR RIVERSIDE TOWNSHIP P.O. BOX 188 RIVERSIDE, NJ 08075
CLERK RIVERSIDE TOWNSHIP P.O. BOX 188 RIVERSIDE, NJ 08075	MAYOR RIVERTON BOROUGH 501 FIFTH ST. RIVERTON, NJ 08077
CLERK RIVERTON BOROUGH 501 FIFTH ST. RIVERTON, NJ 08077	MAYOR SHAMONG TOWNSHIP TUCKERTON RD. R.D. 3 VINCENTOWN, NJ 08088 ATTN: MR. LYNN E. HEINOLD
CLERK SHAMONG TOWNSHIP TUCKERTON RD. R.D. 3 VINCENTOWN, NJ 08088	MAYOR SOUTHAMPTON TOWNSHIP MUNICIPAL HALL MAIN ST. VINCENTOWN, NJ. 08088
CLERK SOUTHAMPTON TOWNSHIP MUNICIPAL HALL MAIN ST. VINCENTOWN, NJ. 08088	MAYOR SPRINGFIELD TOWNSHIP MUNICIPAL HALL JOBSTOWN, NJ 08041

CLERK SPRINGFIELD TOWNSHIP MUNICIPAL HALL JOBSTOWN, NJ 08041	MAYOR TABERNACLE TOWNSHIP CARRANZA RD. R.D. # 3 VINCENTOWN, NJ. 08088
CLERK TABERNACLE TOWNSHIP CARRANZA RD. R.D. # 3 VINCENTOWN, NJ. 08088	MAYOR WASHINGTON TOWNSHIP R.D. 2, BOX 193 EGG HARBOR, NJ 08215
CLERK WASHINGTON TOWNSHIP R.D. 2, BOX 193 EGG HARBOR, NJ 08215	MAYOR WESTAMPTON TOWNSHIP 400 PENNINGTON DRIVE MT. HOLLY, NJ. 08060
CLERK WESTAMPTON TOWNSHIP 400 PENNINGTON DRIVE MT. HOLLY, NJ. 08060	MAYOR WILLINGBORO TOWNSHIP MUNICIPAL COMPLEX SALEM ROAD WILLINGBORO, NJ 08046
CLERK WILLINGBORO TOWNSHIP MUNICIPAL COMPLEX SALEM ROAD WILLINGBORO, NJ 08046	MAYOR WOODLAND TOWNSHIP P.O. BOX 367 CHATSWORTH, NJ. 08019
CLERK WOODLAND TOWNSHIP P.O. BOX 367 CHATSWORTH, NJ. 08019	MAYOR WRIGHTSTOWN BOROUGH P.O. BOX 156 WRIGHTSTOWN, NJ. 08562

CLERK WRIGHTSTOWN BOROUGH P.O. BOX 156 WRIGHTSTOWN, NJ. 08562	MAYOR FIELDSBORO BOROUGH 5 FOURTH ST. FIELDSBORO, NJ. 08505
CLERK FIELDSBORO BOROUGH 5 FOURTH ST. FIELDSBORO, NJ. 08505	MAYOR AUDUBON BORO MUNICIPAL BLDG. OAK ST. & W. ATLANTIC AVE. AUDUBON, NJ. 08106
CLERK AUDUBON BORO MUNICIPAL BLDG. OAK ST. & W. ATLANTIC AVE. AUDUBON, NJ. 08106	MAYOR AUDUBON PARK BORO MUNICIPAL BLDG. 5 PELICAN DRIVE AUDUBON, NJ. 08106
CLERK AUDUBON PARK BORO MUNICIPAL BLDG. 5 PELICAN DRIVE AUDUBON, NJ. 08106	MAYOR BARRINGTON BORO MUNICIPAL BLDG. TRENTON AVE. BARRINGTON, NJ. 08007
CLERK BARRINGTON BORO MUNICIPAL BLDG. TRENTON AVE. BARRINGTON, NJ. 08007	MAYOR BELLMAWR BORO MUNICIPAL BLDG. 21 E. BROWNING RD. BELLMAWR, NJ. 08030
CLERK BELLMAWR BORO MUNICIPAL BLDG. 21 E. BROWNING RD. BELLMAWR, NJ. 08030	MAYOR BERLIN BORO MUNICIPAL BLDG. 59 S. WHITE HORSE PIKE BERLIN, NJ. 08009

MUNICIPAL REPS, CAMDEN COUNTY

MAYOR
COLLINGSWOOD BORO
MUNICIPAL BLDG.
678 HADDON AVE
COLLINGSWOOD, NJ. 08108

MAYOR
GIBBSBORO BORO
MUNICIPAL BLDG.
KIRKWOOD RD.
GIBBSBORO, NJ. 08026

DIRECTOR
GIBBSBORO BOROUGH
ENVIRONMENTAL COMMITTEE
KIRKWOOD ROAD
GIBBSBORO, NJ 08026

CLERK
GLOUCESTER CITY
MUNICIPAL BLDG.
313 MONMOUTH ST.
GLOUCESTER CITY, NJ. 08030

MAYOR
HADDON TWP.
MUNICIPAL BLDG.
HADDON & REEVE AVE.
WESTMONT, NJ. 08108

MAYOR
HADDONFIELD BORO
MUNICIPAL BLDG.
242 KINGS HIGHWAY EAST
HADDONFIELD, NJ. 08033

CLERK
COLLINGSWOOD BORO
MUNICIPAL BLDG.
678 HADDON AVE.
COLLINGSWOOD, NJ. 08108

CLERK
GIBBSBORO BORO
MUNICIPAL BLDG.
KIRKWOOD RD.
GIBBSBORO, NJ. 08026

MAYOR
GLOUCESTER CITY
MUNICIPAL BLDG.
313 MONMOUTH ST.
GLOUCESTER CITY, NJ. 08030

CLERK
GLOUCESTER TWP.
MUNICIPAL BLDG.
CHEWS LANDING - CLEMENTON RD &
HIDER LANE, P.O. BOX 8
BLACKWOOD, NJ. 08012

CLERK
HADDON TWP.
MUNICIPAL BLDG.
HADDON & REEVE AVE.
WESTMONT, NJ. 08108

CLERK
HADDONFIELD BORO
MUNICIPAL BLDG.
242 KINGS HIGHWAY EAST
HADDONFIELD, NJ. 08033

MUNICIPAL REPS, CAMDEN COUNTY

CLERK
BERLIN BORO
MUNICIPAL BLDG.
59 S. WHITE HORSE PIKE
BERLIN, NJ. 08009

CLERK
BERLIN TWP.
MUNICIPAL BLDG.
BATE AVE.
WEST BERLIN, NJ 08091

CLERK
BROOKLAWN BORO
BORO HALL
HAAKON RD.
BROOKLAWN, NJ. 08030

CLERK
CHERRY HILL TWP.
MUNICIPAL BLDG.
820 MERCER ST.
CHERRY HILL, NJ. 08034

MAYOR
CHESILHURST BORO
MUNICIPAL BLDG.
2ND & GRANT AVE.
CHESILHURST, NJ. 08089

MAYOR
CLEMENTON BORO
MUNICIPAL BLDG.
WHITE HORSE AVE.
CLEMENTON, NJ. 08021

MAYOR
BERLIN TWP.
MUNICIPAL BLDG.
BATE AVE.
WEST BERLIN, NJ 08091

MAYOR
BROOKLAWN BORO
BORO HALL
HAAKON RD.
BROOKLAWN, NJ. 08030

MAYOR
CHERRY HILL TWP.
MUNICIPAL BLDG.
820 MERCER ST.
CHERRY HILL, NJ. 08034

DIRECTOR
OF PUBLIC WORKS
CHERRY HILL TOWNSHIP
MUNICIPAL BLDG.
820 MERCER AVE.
CHERRY HILL, NJ 08034

CLERK
CHESILHURST BORO
MUNICIPAL BLDG.
2ND & GRANT AVE.
CHESILHURST, NJ. 08089

CLERK
CLEMENTON BORO
MUNICIPAL BLDG.
WHITE HORSE AVE.
CLEMENTON, NJ. 08021

MUNICIPAL REPS. CAMDEN COUNTY

DIRECTOR
BOROUGH OF HADDONFIELD
ENVIRONMENTAL COMMISSION
MUNICIPAL HALL
242 KINGS HWY EAST
HADDONFIELD, NJ 08033

CLERK
HADDON HEIGHTS BORO
MUNICIPAL BLDG.
625 STATION AVE.
HADDON HEIGHTS, NJ. 08035

CLERK
HI-NELLA BORO
MUNICIPAL BLDG.
100 WYKAGYL ROAD
HI-NELLA, NJ. 08083

CLERK
LAUREL SPRINGS BORO
MUNICIPAL BLDG.
135 BROADWAY
LAUREL SPRINGS, NJ. 08021

CLERK
LAWNSIDE BORO
MUNICIPAL BLDG.
WARWICK ROAD
LAWNSIDE, NJ. 08045

CLERK
LINDENWOLD BORO
MUNICIPAL BLDG.
1017 E. LINDEN AVE.
LINDENWOLD, NJ. 08021

MAYOR
HADDON HEIGHTS BORO
MUNICIPAL BLDG.
625 STATION AVE.
HADDON HEIGHTS, NJ. 08035

MAYOR
HI-NELLA BORO
MUNICIPAL BLDG.
100 WYKAGYL ROAD
HI-NELLA, NJ. 08083

MAYOR
LAUREL SPRINGS BORO
MUNICIPAL BLDG.
135 BROADWAY
LAUREL SPRINGS, NJ. 08021

MAYOR
LAWNSIDE BORO
MUNICIPAL BLDG.
WARWICK ROAD
LAWNSIDE, NJ. 08045

MAYOR
LINDENWOLD BORO
MUNICIPAL BLDG.
1017 E. LINDEN AVE.
LINDENWOLD, NJ. 08021

MAYOR
MAGNOLIA BORO
BORO HALL
438 W. EVESHAM AVE.
MAGNOLIA, NJ. 08049

MUNICIPAL REPS. CAMDEN COUNTY

CLERK
MAGNOLIA BORO
BORO HALL
438 W. EVESHAM AVE.
MAGNOLIA, NJ. 08049

CLERK
MERCHANTVILLE BORO
MUNICIPAL BLDG.
MAPLE & CENTRAL AVE.
MERCHANTVILLE, NJ. 08109

CLERK
MOUNT EPHRAIM BORO
MUNICIPAL BLDG.
121 S. BLACK HORSE PIKE
MOUNT EPHRAIM, NJ. 08059

CLERK
OAKLYN BORO
MUNICIPAL BLDG.
500 WHITE HORSE PIKE
OAKLYN, NJ. 08107

CLERK
PENNSAUKEN TWP.
MUNICIPAL BLDG.
5605 N. CRESCENT BLVD.
PENNSAUKEN, NJ. 08110

CLERK
PINE HILL BORO
BORO HALL
48 W. SIXTH AVE.
PINE HILL, NJ. 08021

MAYOR
MERCHANTVILLE BORO
MUNICIPAL BLDG.
MAPLE & CENTRAL AVE.
MERCHANTVILLE, NJ. 08109

MAYOR
MOUNT EPHRAIM BORO
MUNICIPAL BLDG.
121 S. BLACK HORSE PIKE
MOUNT EPHRAIM, NJ. 08059

MAYOR
OAKLYN BORO
MUNICIPAL BLDG.
500 WHITE HORSE PIKE
OAKLYN, NJ. 08107

MAYOR
PENNSAUKEN TWP.
MUNICIPAL BLDG.
5605 N. CRESCENT BLVD.
PENNSAUKEN, NJ. 08110

MAYOR
PINE HILL BORO
BORO HALL
48 W. SIXTH AVE.
PINE HILL, NJ. 08021

MAYOR
PINE VALLEY BORO
MUNICIPAL BLDG.
CLEMENTON, NJ. 08021

CLERK
PINE VALLEY BORO
MUNICIPAL BLDG.
CLEMENTON, NJ, 08021

MAYOR
RUNNEMEDE BORO
MUNICIPAL BLDG.
5TH AVE. & BLACK HORSE PIKE
RUNNEMEDE, NJ, 08078

CLERK
RUNNEMEDE BORO
MUNICIPAL BLDG.
5TH AVE. & BLACK HORSE PIKE
RUNNEMEDE, NJ, 08078

MAYOR
SOMERDALE BORO
BORO HALL
SOMERDALE & POST ROAD
SOMMERDALE, NJ, 08083

CLERK
SOMERDALE BORO
BORO HALL
SOMERDALE & POST ROAD
SOMMERDALE, NJ, 08083

DIRECTOR
PLANNING DEPT.
SOMERDALE BOROUGH
BOROUGH HALL
SOMERDALE & POST ROADS
SOMERDALE, NJ 08083

CHAIRMAN
BOARD OF HEALTH
BOROUGH OF SOMERDALE
BOROUGH HALL
SOMERDALE & POST ROADS
SOMERDALE, NJ 08083

DIRECTOR
ENVIROMENTAL COMMISSION
BOROUGH OF SOMERDALE
BOROUGH HALL
SOMERDALE & POST ROADS
SOMERDALE, NJ 08083

MAYOR
STRATFORD BORO
BORO HALL
307 UNION AVE
STRATFORD, NJ, 08084

CLERK
STRATFORD BORO
BORO HALL
307 UNION AVE
STRATFORD, NJ, 08084

MAYOR
TAVISTOCK BORO
MUNICIPAL BLDG.
TRENTON AVE.
HARRINGTON, NJ.

CLERK
TAVISTOCK BORO
MUNICIPAL BLDG.
TRENTON AVE.
HARRINGTON, NJ.

MAYOR
VOORHEES TWP.
MUNICIPAL BLDG.
620 BERLIN ROAD
VOORHEES, NJ, 08043

CLERK
VOORHEES TWP.
MUNICIPAL BLDG.
620 BERLIN ROAD
VOORHEES, NJ, 08043

MAYOR
WATERFORD TW.
MUNICIPAL BLDG.
258 W. FRONT ST.
ATCO, NJ, 08004

CLERK
WATERFORD TWP.
MUNICIPAL BLDG.
258 W. FRONT ST.
ATCO, NJ, 08004

MAYOR
WINSLOW TWP.
MUNICIPAL BLDG.
RD 5
HAMMONTON, NJ, 08037

CLERK
WINSLOW TWP.
MUNICIPAL BLDG.
RD 5
HAMMONTON, NJ, 08037

MAYOR
WOODLYNE BORO
MUNICIPAL BLDG.
COOPER AVE.
WOODLYNE, NJ, 08107

CLERK
WOODLYNE BORO
MUNICIPAL BLDG.
COOPER AVE.
WOODLYNE, NJ, 08107

MAYOR
CITY OF CAMDEN
CITY HALL
CAMDEN, NJ, 08101

PRESIDENT OF CITY COUNCIL
CITY HALL
COURT HOUSE SQUARE
CAMDEN, NJ 08102

DIRECTOR, DEPT. OF ENGINEERING
CITY OF CAMDEN
COURT HOUSE SQUARE
CAMDEN, NJ 08102

CLERK
CITY OF CAMDEN
CITY HALL
CAMDEN, NJ, 08101

MUNICIPAL REPS. CAMDEN COUNTY

CHAIRMAN, PLANNING BOARD
CITY OF CAMDEN
22 HADDON AVE
CAMDEN, NJ 08103

DIRECTOR, PUBLIC WORKS DEPARTMENT
CITY OF CAMDEN
COURT HOUSE SQUARE
CAMDEN, NJ 08102

DIRECTOR,
OFFICE OF INTERGOVERNMENTAL
RELATIONS
CITY OF CAMDEN
CAMDEN, NJ 08102

CLERK
AVALON BOROUGH
3100 DUNE DR.
AVALON, N.J. 08202

CLERK,
CAPE MAY CITY
CITY HALL
645 WASHINGTON AV.
CAPE MAY, N.J. 08204

CLERK,
CAPE MAY POINT
LIGHTHOUSE AVE.
CAPE MAY, N.J. 08212

PLANNING DIRECTOR
OFFICE OF PLANNING & RENEWAL
CITY OF CAMDEN
CITY HALL
COURT HOUSE SQUARE
CAMDEN, NJ 08102

DIRECTOR, DEPARTMENT OF RECREATIO
CITY OF CAMDEN
COURT HOUSE SQUARE
CAMDEN, NJ 08102

MAYOR
AVALON BOROUGH
3100 DUNE DR.
AVALON, N.J. 08202

MAYOR,
CAPE MAY CITY
CITY HALL
645 WASHINGTON AV.
CAPE MAY, N.J. 08204

MAYOR
CAPE MAY POINT
LIGHTHOUSE AVE.
CAPE MAY, N.J. 08212

MAYOR,
DENNIS TOWNSHIP
BOROUGH HALL
DENNISVILLE RD. & PETERSBURG RD.
DENNISVILLE, N.J. 08214

MUNICIPAL REPS. CAPE MAY COUNTY

CLERK,
DENNIS TOWNSHIP
BOROUGH HALL
DENNISVILLE RD. & PETERSBURG RD.
DENNISVILLE, N.J. 08214

CLERK,
LOWER TOWNSHIP
OLD SHORE RD.
COLD SPRING, N.J. 08204

CLERK,
MIDDLE TOWNSHIP
31 MECHANIC ST.
CAPE MAY C.H., N.J. 08210

CLERK,
NORTH WILDWOOD
CITY HALL
901 ATLANTIC AVE.
WILDWOOD, N.J. 08260

CLERK,
OCEAN CITY
CITY HALL
OCEAN CITY, N.J. 08226

CLERK,
SEA ISLE CITY
CITY HALL
4416 LANDIS AVE.
SEA ISLE CITY, N.J. 08243

MAYOR,
LOWER TOWNSHIP
OLD SHORE RD.
COLD SPRING, N.J. 08204

MAYOR,
MIDDLE TOWNSHIP
31 MECHANIC ST.
CAPE MAY C.H., N.J. 08210

MAYOR,
NORTH WILDWOOD
CITY HALL
901 ATLANTIC AVE.
WILDWOOD, N.J. 08260

MAYOR,
OCEAN CITY
CITY HALL
OCEAN CITY, N.J. 08226

MAYOR,
SEA ISLE CITY
CITY HALL
4416 LANDIS AVE.
SEA ISLE CITY, N.J. 08243

MAYOR,
STONE HARBOR
9508 - 2ND AVE.
STONE HARBOR, N.J. 08247

MUNICIPAL REPS, CAPE MAY COUNTY

CLERK,
STONE HARBOR
9508 - 2ND AVE.
STONE HARBOR, N.J. 08247

MAYOR,
UPPER TOWNSHIP
CITY HALL
TUCKAHOE, N.J. 08250

CLERK,
UPPER TOWNSHIP
CITY HALL
TUCKAHOE, N.J. 08250

MAYOR,
WEST CAPE MAY
BOROUGH HALL
4TH AVENUE
WEST CAPE MAY, N.J. 08204

CLERK
WEST CAPE MAY
BOROUGH HALL
4TH AVENUE
WEST CAPE MAY, N.J. 08204

MAYOR,
WEST WILDWOOD
701 W. GLENWOOD AVE.
WILDWOOD, N.J. 08260

CLERK,
WEST WILDWOOD
701 W. GLENWOOD AVE.
WILDWOOD, N.J. 08260

MAYOR
WILDWOOD CITY
CITY HALL
4400 N.J. AVE.
WILDWOOD, N.J. 08260

CLERK,
WILDWOOD CITY
CITY HALL
4400 N.J. AVE.
WILDWOOD, N.J. 08260

MAYOR,
WILDWOOD CREST
6101 PACIFIC AVE.
WILDWOOD, N.J. 08260

CLERK
WILDWOOD CREST
6101 PACIFIC AVE.
WILDWOOD, N.J. 08260

MAYOR,
WOODBINE BOROUGH
BOROUGH HALL
ADAMS AVE. & DE HIRSCH AVE.
WOODBINE, N.J. 08270

MUNICIPAL REPS, CUMBERLAND COUNTY

CLERK,
WOODBINE BOROUGH
BOROUGH HALL
ADAMS AVE. & DE HIRSCH AVE.
WOODBINE, N.J. 08270

MAYOR
BRIDGETON CITY
168 E. COMMERCE
BRIDGETON, N.J. 08302

CLERK
BRIDGETON CITY
168 E. COMMERCE
BRIDGETON, N.J. 08302

CLERK
COMMERCIAL TOWNSHIP
53 E BROWN ST.
PORT NORRIS, N.J. 08349

CLERK
DEERFIELD TOWNSHIP
TOWN HALL
MORTN AVE.
DEERFIELD, N.J. 08313

CLERK
DOWNE TOWNSHIP
BRIDGETON, N.J. 08302

CLERK
FAIRFIELD TOWNSHIP
TOWN HALL
MAIN ST.
FAIRTON, N.J. 08320

CLERK
GREENWICH TOWNSHIP
TOWN HALL
GREENWICH, N.J. 08323

CLERK
HOPEWELL TOWNSHIP
TOWN HALL
HOPEWELL, N.J. 08525

CLERK
LAWRENCE TOWNSHIP
11 N MAIN ST.
CEDARVILLE, N.J. 08311

CLERK
MAURICE RIVER TOWNSHIP
TOWN HALL
LEESBURG, N.J. 08327

MAYOR
MILLVILLE CITY
CITY HALL
5 HIGH ST
MILLVILLE, N.J. 08332

MUNICIPAL REPS, CUMBERLAND COUNTY

CLERK MILLVILLE CITY CITY HALL S HIGH ST. MILLVILLE, N.J. 08332	CLERK UPPER DEERFIELD TOWNSHIP TOWN HALL DEERFIELD, N.J. 08313
MAYOR VINELAND CITY CITY HALL 7TH & WOOD STS. VINELAND, N.J. 08360	CLERK VINELAND CITY CITY HALL 7TH & WOOD STS. VINELAND, N.J. 08360
MAYOR BOROUGH OF CLAYTON BOROUGH HALL CLAYTON, NJ 08312	CLERK BOROUGH OF CLAYTON BOROUGH HALL CLAYTON, NJ 08312
MAYOR TOWNSHIP OF DEPTFORD TOWN HALL WESTVILLE, NJ 08093	CLERK TOWNSHIP OF DEPTFORD TOWN HALL WOODBURY, NJ 08096
MAYOR TOWNSHIP OF EAST GREENWICH TOWN HALL MICKLETON, NJ 08056	CLERK TOWNSHIP OF EAST GREENWICH TOWN HALL GLASSBORO, NJ 08028
MAYOR TOWNSHIP OF ELK TOWN HALL MONROEVILLE, NJ 08343	CLERK TOWNSHIP OF ELK TOWN HALL GLASSBORO, 08028
MAYOR TOWNSHIP OF FRANKLIN TOWN HALL FRANKLINVILLE, NJ 08322	CLERK TOWNSHIP OF FRANKLIN TOWN HALL FRANKLINVILLE, NJ 08322

MUNICIPAL REPS, GLOUCESTER COUNTY

MAYOR BOROUGH OF GLASSBORO BOROUGH HALL GLASSBORO, NJ 08028	CLERK BOROUGH OF GLASSBORO BOROUGH HALL GLASSBORO, NJ 08028
MAYOR TOWNSHIP OF GREENWICH TOWN HALL GIBBSTOWN, NJ 08027	CLERK TOWNSHIP OF GREENWICH TOWN HALL GIBBSTOWN, NJ 08027
MAYOR TOWNSHIP OF HARRISON MUNICIPAL BLDG RICHWOOD, NJ 08074	CLERK TOWNSHIP OF HARRISON MUNICIPAL BLDG MULLICA HILL, NJ 08062
MAYOR TOWNSHIP OF LOGAN TOWN HALL BRIDGEPORT, NJ 08014	CLERK TOWNSHIP OF LOGAN TOWN HALL BRIDGEPORT, NJ 08014
MAYOR TOWNSHIP OF MANTUA MUNICIPAL BLDG SEWELL, NJ 08080	CLERK TOWNSHIP OF MANTUA MUNICIPAL BLDG MANTUA, NJ 08051
MAYOR TOWNSHIP OF MONROE MUNICIPAL HALL WILLIAMSTOWN, NJ 08094	CLERK TOWNSHIP OF MONROE MUNICIPAL HALL WILLIAMSTOWN, NJ 08094
MAYOR BOROUGH OF NATIONAL PARK MUNICIPAL BLDG NATIONAL PARK, NJ 08063	CLERK BOROUGH OF NATIONAL PARK MUNICIPAL BLDG NATIONAL PARK, NJ 08063

MUNICIPAL REPS, GLOUCESTER COUNTY

MAYOR BOROUGH OF NEWFIELD BOROUGH HALL NEWFIELD, NJ 08344	CLERK BOROUGH OF NEWFIELD BOROUGH HALL NEWFIELD, NJ 08344
MAYOR BOROUGH OF PAULSBORO BOROUGH HALL PAULSBORO, NJ 08066	CLERK BOROUGH OF PAULSBORO BOROUGH HALL PAULSBORO, NJ 08066
MAYOR BOROUGH OF PITMAN BOROUGH HALL PITMAN, NJ 08071	CLERK BOROUGH OF PITMAN BOROUGH HALL PITMAN, NJ 08071
MAYOR TOWNSHIP OF SOUTH HARRISON TOWN HALL HARRISONVILLE, NJ 08039	CLERK TOWNSHIP OF SOUTH HARRISON TOWN HALL MULLICA HILL, NJ 08062
MAYOR BOROUGH OF SWEDESBORO BOROUGH HALL SWEDESBORO, NJ 08085	CLERK BOROUGH OF SWEDESBORO BOROUGH HALL SWEDESBORO, NJ 08085
MAYOR TOWNSHIP OF WASHINGTON MUNICIPAL BLDG TURNERSVILLE, NJ 08012	CLERK TOWNSHIP OF WASHINGTON MUNICIPAL BLDG TURNERSVILLE, NJ 08012
MAYOR BOROUGH OF WENONAH BOROUGH HALL WENONAH, NJ 08090	CLERK BOROUGH OF WENONAH BOROUGH HALL WENONAH, NJ 08090

MUNICIPAL REPS, GLOUCESTER COUNTY

TOWNSHIP COMMITTEE CHAIRMAN TOWNSHIP OF WEST DEPTFORD TOWN HALL THOROFARE, NJ 08086	CLERK TOWNSHIP OF WEST DEPTFORD TOWN HALL THOROFARE, NJ 08086
MAYOR BOROUGH OF WESTVILLE BOROUGH HALL WESTVILLE, NJ 08093	CLERK BOROUGH OF WESTVILLE BOROUGH HALL WESTVILLE, NJ 08093
MAYOR CITY OF WOODBURY CITY HALL WOODBURY, NJ 08096	CLERK CITY OF WOODBURY CITY HALL WOODBURY, NJ 08096
MAYOR BOROUGH OF WOODBURY HEIGHTS MUNICIPAL BLDG WOODBURY HTS, NJ 08097	CLERK BOROUGH OF WOODBURY HEIGHTS MUNICIPAL BLDG WOODBURY HTS, NJ 08097
MAYOR TOWNSHIP OF WOOLWICH TOWN HALL SWEDESBORO, NJ 08085	CLERK TOWNSHIP OF WOOLWICH TOWN HALL SWEDESBORO, NJ 08085
CLERK, ALLOWAY TOWNSHIP MAIN ST, ALLOWAY, N.J. 08001	MAYOR, ELMER BOROUGH BOROUGH HALL S. MAIN ST. ELMER, N.J. 08318
CLERK, ELMER BOROUGH BOROUGH HALL S. MAIN ST. ELMER, N.J. 08318	CLERK, MANNINGTON TOWNSHIP TOWNSHIP HALL SALEM-WOODSTOWN RD. SALEM, N.J. 08079

MUNICIPAL REPS, SALEM COUNTY

CLERK,
OLDMANS TOWNSHIP
TOWN HALL
PEDRICKTOWN, N.J. 08067

CLERK,
PENNS GROVE BOROUGH
W. MAIN & STATE STS.
PENNS GROVE, N.J. 08069

CLERK,
PITTSGROVE TOWNSHIP
MUNICIPAL BUILDING
CENTERTON-ELMER RD.
ELMER, N.J. 08318

MAYOR,
SALEM CITY
MUNICIPAL BUILDING
SALEM, N.J. 08079

CLERK,
UPPER PENNS NECK TOWNSHIP
D ST.
CARNEYS POINT, N.J. 08069

MAYOR,
WOODSTOWN BOROUGH
BOROUGH HALL
WEST AVENUE
WOODSTOWN, N.J. 08098

MAYOR,
PENNSGROVE BOROUGH
W. MAIN & STATE STS.
PENNS GROVE, N.J. 08069

CLERK,
PILESGROVE TOWNSHIP
TOWN HALL
CREAMERY AVENUE
WOODSTOWN, N.J. 08098

CLERK,
QUINTON TOWNSHIP
MUNICIPAL BUILDING
QUINTON-HANCOCK BLDG. RD.
QUINTON, N.J. 08072

CLERK,
SALEM CITY
318-320 E. BROADWAY
SALEM CITY, N.J. 08079

CLERK,
UPPER PITTSGROVE TOWNSHIP
TOWNSHIP HALL
CARNEYS POINT, N.J. 08069

CLERK,
WOODSTOWN BOROUGH
BOROUGH HALL
WEST AVENUE
WOODSTOWN, N.J. 08098

MUNICIPAL REPS, SALEM COUNTY

MAYOR
PENNSVILLE TOWNSHIP
90 N. BROADWAY
PENNSVILLE, N.J. 08070

CHAIRMAN OF SUPERVISORS
BEDMINISTER TOWNSHIP
TOWNSHIP BUILDING
BEDMINISTER, PA 18910

CHAIRMAN OF SUPERVISORS
BRIDGETON TOWNSHIP
TOWNSHIP BUILDING
UPPER BLACK EDDY, PA 18972

PRESIDENT OF COMMISSIONERS
BRISTOL TOWNSHIP
TOWNSHIP BUILDING
2501 OXFORD VALLEY ROAD
LEVITTOWN, PA 19057

MAYOR
CHALFONT BOROUGH
BOROUGH BUILDING
101 NORTH MAIN STREET
CHALFONT, PA 18914

CHAIRMAN OF SUPERVISORS
DOYLESTOWN TOWNSHIP
TOWNSHIP BUILDING
425 WELLS ROAD
DOYLESTOWN, PA 18901

CLERK
PENNSVILLE TOWNSHIP
90 N. BROADWAY
PENNSVILLE, N.J. 08070

CHAIRMAN OF SUPERVISORS
BENSALEM TOWNSHIP
TOWNSHIP BUILDING
3800 HULMEVILLE RD.
CORNWELLS HEIGHTS, PA 19020

MAYOR
BRISTOL BOROUGH
BOROUGH BUILDING
BRISTOL, PA 19007

CHAIRMAN OF SUPERVISORS
BUCKINGHAM TOWNSHIP
TOWNSHIP BUILDING - HUGHESIAN BLDG
BOX 413
BUCKINGHAM, PA 18912

MAYOR
DOYLESTOWN BOROUGH
BOROUGH BUILDING
18 NORTH MAIN ST.
DOYLESTOWN, PA 18901

MAYOR
DUBLIN BOROUGH
BOROUGH BUILDING
BOX 52
DUBLIN, PA 18917

MUNICIPAL REPS, BUCKS COUNTY

CHAIRMAN OF SUPERVISORS
DURHAM TOWNSHIP
TOWNSHIP BUILDING
DURHAM, PA 18039

CHAIRMAN OF SUPERVISORS
FALLS TOWNSHIP
TOWNSHIP BUILDING
265 YARDLEY AVE.
FALLINGTON, PA 19054

CHAIRMAN OF SUPERVISORS
HAYCOCK TOWNSHIP
TOWNSHIP BUILDING
QUAKERTOWN, PA 18951

MAYOR
HULMEVILLE BOROUGH
BOROUGH BUILDING
114 TRENTON AVE.
HULMEVILLE, PA 19047

MAYOR
LANGHORNE BOROUGH
BOROUGH BUILDING
114 EAST MAPLE AVE.
LANGHORNE, PA 19047

CHAIRMAN OF SUPERVISORS
LOWER MAKEFIELD TOWNSHIP
TOWNSHIP BUILDING
1100 EDGEWOOD ROAD
YARDLEY, PA 19067

CHAIRMAN OF SUPERVISORS
EAST ROCKHILL TOWNSHIP
TOWNSHIP BUILDING
1622 RIDGE ROAD
PERKASIE, PA 18944

MANAGER
FALLS TOWNSHIP
TOWNSHIP BUILDING
265 YARDLEY AVENUE
FALLSINGTON, PA 19054

CHAIRMAN OF SUPERVISORS
HILLTOWN TOWNSHIP
TOWNSHIP BUILDING
BOX 15
SILVERDALE, PA 18962

MAYOR
IVYLAND BOROUGH
BOROUGH BUILDING
IVYLAND, PA 18974

MAYOR
LANGHORNE MANOR BOROUGH
BOROUGH BUILDING
LANGHORNE MANOR, 618 HULMEVILLE AV
LANGHORNE, PA 19047

CHAIRMAN OF SUPERVISORS
LOWER SOUTHAMPTON TOWNSHIP
TOWNSHIP BUILDING
1500 DESIRE AVE.
FEASTERVILLE, PA 19047

MUNICIPAL REPS, BUCKS COUNTY

CHAIRMAN OF SUPERVISORS
MIDDLETOWN TOWNSHIP
TOWNSHIP BUILDING
700 NEW RODGERS RD.
LEVITTOWN, PA 19056

MAYOR
MORRISVILLE BOROUGH
MUNICIPAL BUILDING
35 UNION ST.
MORRISVILLE, PA 19067

CHAIRMAN OF SUPERVISORS
NEW BRITAIN TOWNSHIP
TOWNSHIP BUILDING
615 LIMEKILN PIKE
CHALFONT, PA 18914

MAYOR
NEWTOWN BOROUGH
BOROUGH BUILDING
NEWTOWN, PA 18940

CHAIRMAN OF SUPERVISORS
NOCKAMIXON TOWNSHIP
TOWNSHIP BUILDING
KINTNERSVILLE, PA 18930

MAYOR
PENNDEL BOROUGH
BOROUGH BUILDING
PENNDEL, PA 19047

CHAIRMAN OF SUPERVISORS
MILFORD TOWNSHIP
TOWNSHIP BUILDING
RD NO. 2
QUAKERTOWN, PA 18951

MAYOR
NEW BRITAIN BOROUGH
BOROUGH BUILDING
NEW BRITAIN, PA 18901

MAYOR
NEW HOPE BOROUGH
BOROUGH HALL
MECHANIC AND MAIN STREET
NEW HOPE, PA 18938

MAYOR
NEWTOWN TOWNSHIP
TOWNSHIP BUILDING
BOX 318
NEWTOWN, PA 18940

CHAIRMAN OF SUPERVISORS
NORTHAMPTON TOWNSHIP
TOWNSHIP BUILDING
990 SECOND STREET PIKE
RICHBORO, PA 18954

MAYOR
PERKASIE BOROUGH
BOROUGH BUILDING
607 CHESTNUT ST.
PERKASIE, PA 18944

MUNICIPAL REPS, BUCKS COUNTY

CHAIRMAN OF SUPERVISORS
PLUMSTEAD TOWNSHIP
TOWNSHIP BUILDING
STUMP ROAD
PLUMSTEADVILLE, PA 18949

PRESIDENT OF COUNCIL
RICHLAND TOWNSHIP
TOWNSHIP BUILDING
745 E. CHERRY RD.
QUAKERTOWN, PA 18951

MAYOR
RIEGELSVILLE BOROUGH
RIEGELSVILLE SOCIETY HALL
EASTON ROAD
RIEGELSVILLE, PA 18077

MAYOR
SILVERDALE BOROUGH
BOROUGH BUILDING
SILVERDALE, PA 18962

CHAIRMAN OF SUPERVISORS
SPRINGFIELD TOWNSHIP
TOWNSHIP BUILDING
COOPERSBURG, PA 18036

CHAIRMAN OF SUPERVISORS
TINICUM TOWNSHIP
TOWNSHIP BUILDING
UPPER BLACK EDDY, PA 18920

MAYOR
QUAKERTOWN BOROUGH
BOROUGH BUILDING
300 WEST BROAD STREET
QUAKERTOWN, PA 18951

MAYOR
RICHLANDTOWN BOROUGH
BOROUGH BUILDING
RICHLANDTOWN, PA 18955

MAYOR
SELLERSVILLE BOROUGH
MUNICIPAL BUILDING
140 E. CHURCH ST.
SELLERSVILLE, PA 18960

CHAIRMAN OF SUPERVISORS
SOLEBURY TOWNSHIP
TOWNSHIP BUILDING
BOX 93 , SUGAN RD.
SOLEBURY, PA 18963

MAYOR
TELFORD BOROUGH
BOROUGH BUILDING
122 PENNSYLVANIA AVE.
TELFORD, PA 18969

MAYOR
TRUMBAUERSVILLE BOROUGH
TRUMBAUERSVILLE FIRE HOUSE
150 N. MAIN ST.
TRUMBAUERSVILLE, PA 18970

MUNICIPAL REPS, BUCKS COUNTY

MAYOR
TULLYTOWN BOROUGH
BOROUGH
500 MAIN STREET
TULLYTOWN, PA 19007

CHAIRMAN OF SUPERVISORS
UPPER SOUTHAMPTON TOWNSHIP
TOWNSHIP BUILDING
939 STREET ROAD
SOUTHAMPTON, PA 18966

CHAIRMAN OF SUPERVISORS
WARRINGTON TOWNSHIP
TOWNSHIP BUILDING
MILL CREEK AND PICKERTOWN RDS.
WARRINGTON, PA 18976

CHAIRMAN OF SUPERVISORS
WEST ROCKHILL TOWNSHIP
TOWNSHIP BUILDING
SELLERSVILLE, PA 18960

MAYOR
YARDLEY BOROUGH
BOROUGH BUILDING
56 SOUTH MAIN STREET
YARDLEY, PA 19067

MAYOR
ALDAN BOROUGH
26 SO. SYCAMORE AVE
ALDAN, PA, 19018

CHAIRMAN OF SUPERVISORS
UPPER WAKEFIELD TOWNSHIP
TOWNSHIP BUILDING
R.D. NO. 2
NEWTOWN, PA 18940

CHAIRMAN OF SUPERVISORS
WARMINSTER TOWNSHIP
TOWNSHIP BUILDING
HENRY AND GIBSON AVE.
WARMINSTER, PA 18974

CHAIRMAN OF SUPERVISORS
WARWICK TOWNSHIP
TOWNSHIP BUILDING
WARMINISTER, PA 18974

CHAIRMAN OF SUPERVISORS
WRIGHTSTOWN TOWNSHIP
TOWNSHIP BUILDING
BOX 500 , PENNS PARK ROAD
WYCOMBE, PA 18980

SUPERVISOR
WILLISTOWN TWP.
RD # 2
SUGARTOWN RD.
MALVERN, PA. 19355

CHAIRMAN
ALDAN BOROUGH PLANNING COMM.
26 SO. SYCAMORE AVE
ALDAN, PA, 19018

MUNICIPAL REPS. DELAWARE COUNTY

SECRETARY
ALDAN BOROUGH
25 S. SYCAMORE AVE.
ALDAN, PA. 19018

PRESIDENT, BOARD OF COMMISSIONERS
ASTON TOWNSHIP
P. O. BOX 1
ASTON, PA. 19014

MR. MARC LAMER
COMMISSIONER, ASTON TWP.
2[illegible] HAZEL LANE, PENNELL MANOR
MEDIA, PA. 19063

MR. STEPHEN M. SCHRIVER
COMMISSIONER, ASTON TWP.
27 NEW ROAD
ASTON, PA. 19014

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ASTON TOWNSHIP PLANNING COMM.
P. O. BOX 1
ASTON, PA. 19014

SECRETARY
ASTON TOWNSHIP
P. O. BOX 1
ASTON, PA. 19014

SUPERVISOR
BETHEL TOWNSHIP
P. O. BOX 2137
BOOTHWYN, PA. 19061

CHAIRMAN
BETHEL TOWNSHIP PLANNING COMMISSIO
P. O. BOX 2137
BOOTHWYN, PA. 19061

SECRETARY
BETHEL TOWNSHIP
P.O. BOX 2137
BOOTHWYN, PA. 19061

SUPERVISOR
BIRMINGHAM TOWNSHIP
BOX 181
CHADDS FORD, PA. 19317

CHAIRMAN
BIRMINGHAM TWP. PLANNING COMM.
BOX 181
CHADDS FORD, PA. 19317

SECRETARY
BIRMINGHAM TOWNSHIP
BOX 181
CHADDS FORD, PA. 19317

MAYOR
BROOKHAVEN BOROUGH
BROOKHAVEN RD. & EDGEMONT AVE.
BROOKHAVEN, PA. 19015

CHAIRMAN
BROOKHAVEN BOROUGH PLANNING COMM.
BROOKHAVEN RD. & EDGEMONT AVE.
BROOKHAVEN, PA. 19015

MUNICIPAL REPS. DELAWARE COUNTY

SECRETARY
BROOKHAVEN BOROUGH
BROOKHAVEN RD. & EDGEMONT AVE.
BROOKHAVEN, PA. 19015

MAYOR
CITY OF CHESTER
MUNICIPAL BLDG.
5TH & WELSH STS.
CHESTER, PA. 19013

CHAIRMAN
CITY OF CHESTER PLANNING COMM.
MUNICIPAL BLDG.
5TH & WELSH STS.
CHESTER, PA. 19013

SECRETARY
CITY OF CHESTER
MUNICIPAL BLDG.
5TH & WELSH STS.
CHESTER, PA. 19013

PLANNING DEPARTMENT
CITY OF CHESTER
FIDELITY BLDG.
CHESTER, PA. 19013

REDEVELOPMENT AUTHORITY DIRECTOR
CITY OF CHESTER
FIDELITY BLDG
CHESTER,PA. 19013

HOUSING AUTHORITY DIRECTOR
CITY OF CHESTER
6 W. 6TH ST.
CHESTER, PA. 19013

SUPERVISOR
CHESTER TOWNSHIP
1327 PETERSON ST.
CHESTER, PA. 19013

CHAIRMAN
CHESTER TOWNSHIP PLANNING COMM.
1327 PETERSON ST.
CHESTER, PA. 19013

SECRETARY
CHESTER TOWNSHIP
1327 PETERSON ST.
CHESTER, PA. 19013

MAYOR
BORO. OF CHESTER HEIGHTS
BOX 27
CHESTER HEIGHTS, PA. 19017

CHAIRMAN
BORO. OF CHESTER HGTS. PLNNG. COMM
BOX 27
CHESTER HEIGHTS, PA. 19017

SECRETARY
BORO. OF CHESTER HEIGHTS
BOX 27
CHESTER HEIGHTS PA. 19017

MAYOR
CLIFTON HEIGHTS BOROUGH
7 S. SPROUL RD.
CLIFTON HEIGHTS, PA. 19018

MUNICIPAL REPS, DELAWARE COUNTY

CHAIRMAN
CLIFTON HGTS. BORO. PLANNING COMM.
7 S. SPROUL RD.
CLIFTON HEIGHTS, PA. 19018

MAYOR
BOROUGH OF COLLINGDALE
237 CLIFTON AVE.
COLLINGDALE, PA. 19023

SECRETARY
BOROUGH OF COLLINGDALE
237 CLIFTON AVE.
COLLINGDALE, PA. 19023

CHAIRMAN
COLWYN PLANNING COMM.
570 S. 4TH ST.
COLWYN, PA. 19023

SUPERVISOR
CONCORD TOWNSHIP
BOX 171
CONCORDVILLE, PA 19331

SECRETARY
CONCORD TOWNSHIP
BOX 171
CONCORDVILLE, PA. 19331

CHAIRMAN
DARBY PLANNING COMM.
44 N. 9TH ST.
DARBY, PA. 19023

SECRETARY
CLIFTON HEIGHTS BOROUGH
7 S. SPROUL RD.
CLIFTON HEIGHTS, PA. 19018

CHAIRMAN
COLLINGDALE PLANNING COMM.
237 CLIFTON AVE.
COLLINGDALE, PA. 19023

MAYOR
BOROUGH OF COLWYN
570 S. 4TH ST.
COLWYN, PA. 19023

SECRETARY
BOROUGH OF COLWYN
570 S. 4TH ST.
COLWYN, PA. 19023

CHAIRMAN
CONCORD TOWNSHIP PLANNING COMM.
BOX 171
CONCORDVILLE, PA 19331

MAYOR
BOROUGH OF DARBY
44 N. 9TH ST.
DARBY, PA. 19023

SECRETARY
BOROUGH OF DARBY
44 N. 9TH ST.
DARBY, PA. 19023

MUNICIPAL REPS, DELAWARE COUNTY

MAYOR
DARBY TOWNSHIP
603 W. ASHLAND AVE.
GLENOLDEN, PA. 19036

SECRETARY
DARBY TOWNSHIP
603 W. ASHLAND AVE.
GLENOLDEN, PA. 19036

CHAIRMAN
EAST LANSDOWNE PLANNING COMM.
155 HIRST AVE.
EAST LANSDOWNE, PA. 19105

MAYOR
EDDYSTONE BOROUGH
12TH & SAVILLE AVE.
EDDYSTONE, PA. 19013

SECRETARY
EDDYSTONE BOROUGH
12TH & SAVILLE AVE.
EDDYSTONE, PA. 19013

CHAIRMAN
EDGMONT TWP. PLANNING COMM.
GRADYVILLE, PA. 19039

MAYOR
BOROUGH OF FOLCROFT
1555 BALTIMORE AVE.
FOLCROFT, PA. 19032

CHAIRMAN
DARBY PLANNING COMM.
603 W. ASHLAND AVE.
GLENOLDEN, PA. 19036

MAYOR
EAST LANSDOWNE
155 HIRST AVE.
EAST LANSDOWNE, PA. 19105

SECRETARY
EAST LANSDOWNE
155 HIRST AVE.
EAST LANSDOWNE, PA. 19105

CHAIRMAN
EDDYSTONE BOROUGH PLANNING COMM
12TH & SAVILLE AVE.
EDDYSTONE, PA. 19013

SUPERVISOR
EDGMONT TOWNSHIP
GRADYVILLE, PA. 19039

SECRETARY
EDGMONT TOWNSHIP
GRADYVILLE, PA. 19039

CHAIRMAN
BORO. OF FOLCROFT PLANNING COMM
1555 BALTIMORE AVE.
FOLCROFT, PA. 19032

MUNICIPAL REPS, DELAWARE COUNTY

SECRETARY
BOROUGH OF FOLCROFT
1555 BALTIMORE AVE.
FOLCROFT, PA. 19032

CHAIRMAN
BORO. OF GLENOLDEN PLANNING COMM.
36 E. BOON AVE.
GLENOLDEN, PA. 19036

MAYOR
TOWNSHIP OF HAVERTOWN
2325 DARBY ROAD
HAVERTOWN, PA 19083

SECRETARY
TOWNSHIP OF HAVERTOWN
2325 DARBY ROAD
HAVERTOWN, PA. 19083

CHAIRMAN
BORO OF LANSDOWNE PLANNING COMM.
12 E. BALTIMORE AVE.
LANSDOWNE, PA 19050

MAYOR
LOWER CHICHESTER
P. O. BOX 1255
LINWOOD, PA 19061

SECRETARY
LOWER CHICHESTER
P.O. BOX 1255
LINWOOD, PA. 19061

MAYOR
BOROUGH OF GLENOLDEN
36 E. BOON AVE.
GLENOLDEN, PA. 19036

SECRETARY
BOROUGH OF GLENOLDEN
26 E. BOON AVE.
GLENOLDEN, PA. 19036

CHAIRMAN
TWP OF HAVERTOWN PLANNING COMM.
2325 DARBY ROAD
HAVERTOWN, PA 19083

MAYOR
BOROUGH OF LANSDOWNE
12 E. BALTIMORE AVE.
LANSDOWNE, PA 19050

SECRETARY
BOROUGH OF LANSDOWNE
12 E. BALTIMORE AVE.
LANSDOWNE, PA. 19050

CHAIRMAN
LOWER CHICHESTER PLANNING COMM
P. O. BOX 1255
LINWOOD, PA 19061

MAYOR
BOROUGH OF MARCUS HOOK
1031 GREEN ST.
MARCUS HOOK, PA. 19061

MUNICIPAL REPS, DELAWARE COUNTY

CHAIRMAN
BORO OF MARCUS HOOK PLANNING COMM
1031 GREEN ST.
MARCUS HOOK, PA. 19061

MAYOR
TOWNSHIP OF MARPLE
SPRINGFIELD & SPROUL ROADS
BROOMALL, PA. 19008

SECRETARY
TOWNSHIP OF MARPLE
SPRINGFIELD & SPROUL ROADS
BROOMALL, PA. 19008

CHAIRMAN
BORO OF MEDIA PLANNING COMM
P.O. BOX ###
MEDIA, PA 19063

SUPERVISOR
TOWNSHIP OF MIDDLETOWN
P.O. BOX 157
LIMA, PA. 19060

SECRETARY
TOWNSHIP OF MIDDLETOWN
P.O. BOX 157
LIMA, PA. 19060

CHAIRMAN
BORO OF MILLBOURNE PLANNING COMM
PARK AVE
UPPER DARBY, PA 19082

SECRETARY
BOROUGH OF MARCUS HOOK
1031 GREEN ST.
MARCUS HOOK, PA.

CHAIRMAN
TWP OF MARPLE PLANNING COMM
SPRINGFIELD & SPROUL ROADS
BROOMALL, PA. 19008

MAYOR
BOROUGH OF MEDIA
P.O. BOX ###
MEDIA, PA 19063

SECRETARY
BOROUGH OF MEDIA
P.O. BOX 4
MEDIA, PA. 19063

CHAIRMAN
TWP OF MIDDLETOWN PLANNING COMM
P.O. BOX 157
LIMA, PA. 19060

MAYOR
BOROUGH OF MILLBOURNE
PARK AVE.
UPPER DARBY, PA 19082

SECRETARY
BOROUGH OF MILLBOURNE
UPPER DARBY, PA. 19082
UPPER DARBY, PA 19082

MUNICIPAL REPS, DELAWARE COUNTY

MAYOR
BOROUGH OF MORTON
400 HIGHLAND AVE
MORTON, PA, 19070

SECRETARY
BOROUGH OF MORTON
400 HIGHLAND AVE.
MORTON, PA, 19070

CHAIRMAN
NETHER PROVIDENCE TWP PLANNING COM
214 SYKES LANE
WALLINGFORD, PA 19086

MAYOR
NEWTON TOWNSHIP
BOX 313
NEWTON SQUARE, PA 19073

SECRETARY
NEWTON TWP
BOX 313
NEWTON SQUARE, PA 19073

CHAIRMAN
BORO OF NORWOOD PLANNING COMM
P.O. BOX 65
NORWOOD, PA 19074

MAYOR
BOROUGH OF PARKSIDE
2700 EDGEMONT AVE.
PARKSIDE, PA. 19015

CHAIRMAN
BORUGH OF MORTON PLANNING COMM
400 HIGHLAND AVE
MORTON, PA. 19070

MAYOR
NETHER PROVIDENCE TWP
214 SYKES LANE
WALLINGFORD, PA 19086

SECRETARY
NETHER PROVIDENCE TWP
214 SYKES LANE
WALLINGFORD, PA. 19086

CHAIRMAN
NEWTON TOWNSHIP PLANNING COMM
BOX 313
NEWTON SQUARE, PA 19073

MAYOR
BOROUGH OF NORWOOD
P.O. BOX 65
NORWOOD, PA 19074

SECRETARY
BOROUGH OF NORWOOD
P.O. BOX 65
NORWOOD, PA. 19074

CHAIRMAN
BORO OF PARKSIDE PLANNING COMM
2700 EDGEMONT AVE.
PARKSIDE, PA. 19015

MUNICIPAL REPS, DELAWARE COUNTY

SECRETARY
BOROUGH OF PARKSIDE
2700 EDGEMONT AVE.
PARKSIDE, PA. 19015

CHAIRMAN
BORO OF PROSPECT PARK PLANNING COM
720 MARYLAND AVE.
PROSPECT PARK, PA 19076

MAYOR
RADNOR TOWNSHIP
301 IVEN AVE.
WAYNE, PA 19087

SECRETARY
RADNOR TOWNSHIP
301 IVEN AVE
WAYNE, PA. 19087

CHAIRMAN
TOWNSHIP OF RIDLEY PLANNING COMM
MUNICIPAL BUILDING
FOLSOM, PA 19033

MAYOR
BOROUGH OF RIDLEY PARK
WARD & CRESSWELL STS.
RIDLEY PARK, PA 19078

SECRETARY
BOROUGH OF RIDLEY PARK
WARD AND CRESSWELL STS.
RIDLEY PARK, PA 19078

MAYOR
BOROUGH OF PROSPECT PARK
720 MARYLAND AVE.
PROSPECT PARK, PA 19076

SECRETARY
BOROUGH OF PROSPECT PARK
720 MARYLAND AVE.
PROSPECT PARK, PA. 19076

CHAIRMAN
RADNOR TWP PLANNING COMM
301 IVEN AVE.
WAYNE, PA 19087

MAYOR
TOWNSHIP OF RIDLEY
MUNICIPAL BUILDING
FOLSOM, PA 19033

SECRETARY
TOWNSHIP OF RIDLEY
MUNICIPAL BUILDING
FOLSOM, PA. 19033

CHAIRMAN
BORO OF RIDLEY PARK PLANNING COMM
WARD & CRESSWELL STS.
RIDLEY PARK, PA 19078

MAYOR
BOROUGH OF ROSE VALLEY
BOX 198
ROSE VALLEY-MOYLAN, PA 19065

MUNICIPAL REPS. DELAWARE COUNTY

CHAIRMAN
BORO OF ROSE VALLEY PLANNING COMM
BOX 198
ROSE VALLEY-MOYLAN, PA 19065

MAYOR
RUTLEDGE BOROUGH
200 RUTLEDGE AVE.
RUTLEDGE, PA. 19070

SECRETARY
RUTLEDGE BOROUGH
200 RUTLEDGE AVE.
RUTLEDGE, PA. 19070

CHAIRMAN
BORO OF SHARON HILL PLANNING COMM
SHARON AVE. & SPRING ST.
SHARON HILL, PA 19079

MAYOR
SPRINGFIELD TOWNSHIP
50 POWELL RD.
SPRINGFIELD TWP PLANNING COMM

SECRETARY
SPRINGFIELD TOWNSHIP
50 POWELL RD
SPRINGFIELD, PA. 19064

CHAIRMAN
SWARTHMORE PLANNING COMM
121 PARK AVE
SWARTHMORE, PA 19081

SECRETARY
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BOX 198
ROSE VALLEY-MOYLAN, PA 19065

CHAIRMAN
RUTLEDGE PLANNING COMM
200 RUTLEDGE AVE.
RUTLEDGE, PA. 19070

MAYOR
BOROUGH OF SHARON HILL
SHARON AVE. & SPRING ST.
SHARON HILL, PA 19079

SECRETARY
BOROUGH OF SHARON HILL
SHARON AVE & SPRING ST.
SHARON HILL, PA. 19079

CHAIRMAN
SPRINGFIELD TWP PLANNING COMM
50 POWELL RD.
SPRINGFIELD TWP PLANNING COMM

MAYOR
SWARTHMORE
121 PARK AVE
SWARTHMORE, PA 19081

SECRETARY
SWARTHMORE
121 PARK AVE.
SWARTHMORE, PA. 19081

MUNICIPAL REPS. DELAWARE COUNTY

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BOX 50
GLEN MILLS, PA. 19342

SECRETARY
THORNBURY TOWNSHIP
THORNTON, PA. 19373
GLEN MILLS, PA. 19342

CHAIRMAN
TINICUM TWP PLANNING COMM
BOX 24
ESSINGTON, PA 19029

MAYOR
BOROUGH OF TRAINER
9TH & MAIN STS.
TRAINER, PA 19013

SECRETARY
BOROUGH OF TRAINER
9TH & MAIN STS.
TRAINER, PA. 19013

CHAIRMAN
UPLAND BOROUGH PLANNING COMM.
MUNICIPAL BUILDING
UPLAND, PA. 19015

PRESIDENT OF COMMISSIONERS
TOWNSHIP OF UPPER CHICHESTER
P.O. BOX 2136
BOOTHWYN, PA 19061

CHAIRMAN
THORNBURY TWP PLANNING COMM
16 STONE RIDGE RD.
THORNTON, PA. 19373

MAYOR
TINICUM TOWNSHIP
BOX 24
ESSINGTON, PA 19029

SECRETARY
TINICUM TOWNSHIP
BOX 24
ESSINGTON, PA. 19029

CHAIRMAN
BORO OF TRAINER PLANNING COMM
9TH & MAIN STS.
TRAINER, PA 19013

MAYOR
BOROUGH OF UPLAND
MUNICIPAL BUILDING
UPLAND, PA. 19015

SECRETARY
BOROUGH OF UPLAND
MUNICIPAL BUILDING
UPLAND, PA. 19015

CHAIRMAN
TWP OF UPPER CHICHESTER PLANNING C
P.O. BOX 2136
BOOTHWYN, PA 19061

MUNICIPAL REPS, DELAWARE COUNTY

SECRETARY
TWP OF UPPER CHICHESTER
P.O. BOX 2136
BOOTHWYN, PA. 19061

MAYOR
TOWNSHIP OF UPPER DARBY
MUNICIPAL BUILDING
UPPER DARBY, PA 19082

CHAIRMAN
UPPER DARBY PLANNING COMM.
MUNICIPAL BUILDING
UPPER DARBY, PA 19082

SECRETARY
TOWNSHIP OF UPPER DARBY
MUNICIPAL BUILDING
UPPER DARBY, PA. 19082

MAYOR
UPPER PROVIDENCE TWP.
935 N. PROVIDENCE RD
MEDIA, PA. 19063

CHAIRMAN
UPPER PROVIDENCE PLANNING COMM.
935 N. PROVIDENCE RD
MEDIA, PA. 19063

SECRETARY
UPPER PROVIDENCE TWP
935 N. PROVIDENCE RD
MEDIA, PA. 19063

MAYOR
BOROUGH OF YEADON
CHURCH LANE & BAILY RD
YEADON, PA. 19050

CHAIRMAN
BORO OF YEADON PLANNING COMM
CHURCH LANE & BAILY RD
YEADON, PA. 19050

SECRETARY
BOROUGH OF YEADON
CHURCH LANE & BAILY RD
YEADON, PA. 19050

MAYOR
CITY OF PHILADELPHIA
CITY HALL
PHILA, PA 19107

CITY COMMISSIONERS
CITY OF PHILADELPHIA
CITY HALL
PHILA, PA 19107

MANAGING DIRECTOR
CITY OF PHILADELPHIA
1620 MUNICIPAL SERVICES BUILDING
PHILA, PA 19107

DIRECTOR
CITY PLANNING COMMISSION
CITY OF PHILADELPHIA
13 TH FLOOR - CITY HALL ANNEX
PHILADELPHIA, PA 19107

MUNICIPAL REPS, PHILADELPHIA CITY

COMMISSIONER
PHILA, DEPT. OF RECREATION
1450 MUNICIPAL SERVICES BUILDING
PHILA, PA 19107

DIRECTOR
FAIRMOUNT PARK COMMISSION
MEMORIAL HALL
W. FAIRMOUNT PARK
PHILADELPHIA, PA

DIRECTOR
PHILA HOUSING AUTHORITY
2012 CHESTNUT ST.
PHILA, PA 19103

CHAIRMAN
PHILADELPHIA REDEVELOPMENT AUTH.
CITY HALL
PHILA, PA 19107

COMMISSIONER
PHILADELPHIA WATER DEPARTMENT
1160 MUNICIPAL SERVICES BUILDING
PHILA, PA 19107

NAVIGATION INTERESTS

DELAWARE PILOTS ASSOCIATION
LEWES, DE 19958

DELAWARE PILOT COMMISSIONERS
DOVER, DE 19901

MARITIME EXCHANGE
LEWES, DE 19958

NEW CASTLE BOAT CLUB
FOOT OF 3RD ST.
NEW CASTLE, DEL 19720

BORDENTOWN YACHT CLUB
FOOT OF FARNSWORTH AVE.
BORDENTOWN, NJ

FLORENCE YACHT CLUB
FRONT AND BROAD ST.
FLORENCE, NJ

ONEIDA BOAT CLUB
DELAWARE AVE. AND GEORGE ST.
BURLINGTON, NJ 08016

RIVERTON YACHT CLUB
FOOT OF MAIN ST.
RIVERTON, NJ 08077

NAV. INT. BURLINGTON CO.

STAR BOAT CLUB
DELAWARE AVE. AND GEORGE ST.
BURLINGTON, NJ 08016

YAREWI YACHT CLUB
FOOT OF PARK ST.
BORDENTOWN, NJ

FARRAGUT SPORTSMAN'S ASSOCIATION
FOOT OF 25TH ST.
CAMDEN, NJ 08105

GIBBSTOWN BOATING CLUB
OLD FERRY RD
BRIDGEPORT, NJ 08014

NATIONAL PARK BOAT CLUB
RIVERVIEW AVE.
WOODBURY, NJ 08096

SWEDESBORO BOAT CLUB
SWEDEBORO, NJ 08085

WESTVILLE POWER BOAT ASSN.
EDGEWATER AND DEWEY AVES.
WESTVILLE, NJ 08093

CAPITAL CITY YACHT CLUB
LAMBERTON RD.
TRENTON, NJ 08611

ALPHA YACHT CLUB AND MARINA INC.
LOWER ALLOWAYS CREEK TWP, NJ 08038

SALEM BOAT CLUB
BOX 304
PENNSVILLE, NJ. 08070

ANCHOR YACHT CLUB
1209 PINE GROVE ST.
BRISTOL, PA 19007

BRISTOL YACHT CLUB
EDGELY, PA.

PENNSYLVANIA YACHT CLUB
2189 STATE RD.
CORNWELLS HEIGHTS
BENSALEM TWP., PA 19020

CORINTHIAN YACHT CLUB
217 2ND ST.
ESSINGTON, PA 19029

FOLCROFT BOAT CLUB
FOLCROFT, PA 19032

RIVERSIDE YACHT CLUB
WANAMAKER AVE. AND 2ND ST.
ESSINGTON, PA 19029

NAV. INT. DELAWARE CO.

TRISTATE YACHT CLUB 40
TAYLOR AVE. AND DELAWARE RIVER
ESSINGTON, PA 19029

WEST END BOAT CLUB
JEFFREY ST.
CHESTER, PA 19013

COLUMBIA YACHT CLUB
2902 DELAWARE AVE
PHILADELPHIA, PA

DELAWARE RIVER YACHT CLUB
GRANT AVE.
PHILADELPHIA, PA 19114

PILOTS ASSOC. FOR BAY AND DEL. R.
214 S. 11TH ST.
PHILADELPHIA, PA 19107

QUAKER CITY YACHT CLUB
7101 N. DELAWARE AVE.
PHILADELPHIA, PA 19135

VESSEL OWNER AND CAPTAIN ASSOC.
6 PENN CENTER PLAZA
PHILADELPHIA, PA 19103

WISSINOMING YACHT CLUB
6311 DELAWARE AVE.
PHILADELPHIA, PA 19135

PRESIDENT
AMERICAN WATERWAYS OPERATORS, INC.
1600 WILSON BLVD. SUITE 1101
ARLINGTON, VA. 22209

AMERICAN INSTITUTE OF MERCHANT
SHIPPING
1625 K STREET, N.W., SUITE 1000
WASHINGTON, DC 20006

BOAT OWNERS ASSOC. OF THE U.S.
1028 CONNECTICUT AVE.
WASHINGTON, DC 20036

HAMPTON ROADS MARITIME ASSOCIATIO
127-129 BANK ST.
NORFOLK, VA.

CIVIC ORGANIZATIONS AND ASSOCIATIONS

LEAGUE OF WOMEN VOTERS OF DEL
4 KENT WAY
NEWARK, DEL.

MRS JOHN RYAN
ENVR QUAL CHAIRMAN, LWV
2 HARLEY MILL DRIVE
WILMINGTON,DE 19807

CIVIC ORG, NEW CASTLE COUNTY

DE. LEAGUE OF LOCAL GOV.
LE[illegible] DE VALINGER
134 E. WATER ST., BOX 884
DOVER, DE. 19901

ALAPOCAS PARK CIVIC ASSOC.
J. T. LINTON
9 GRANITE ROAD
WILMINGTON, DE. 19803

ALBERTSON PARK CIVIC ASSOC.
FRANCIS E. BRECCOLI
2141 ELDER DRIVE
WILMINGTON, DE. 19808

ARDENCROFT CIVIC ASSOC.
JOHN BRADSHAW
2119 WILLOW WAY
WILMINGTON, DE. 19810

ARUNDEL CIVIC ASSOC.
MR. DON MULLEN
1215 ARUNDEL DRIVE
WILMINGTON, DE. 19808

MR. WILLIAM BLEIDNER
BROOKLAND TERRACE CIVIC CLUB
4 BEECH TERRACE
BROOKLAND TERRACE
WILMINGTON, DE 19805

BARKLEY CIVIC ASSOC
JOHN J. SCHULTZ
2713 POINT BREEZE DRIVE
WILMINGTON, DE. 19810

AFTON CIVIC ASSOC.
LARRY W. FORTNER
280 FAIRHOPE ROAD
WILMINGTON, DE. 19810

ALBAN PARK CIVIC ASSOC.
RONALD COLEMAN
1528 BONWOOD ROAD
WILMINGTON, DE. 19805

ARBOUR PARK CIVIC ASSOC.
P. O. BOX 92
NEWARK, DE. 19711

ARDENTOWN, TRUSTEES & LEASEHOL
FRANCIS BURCH
2205 SWISS LANE
WILMINGTON, DE. 19810

ASHBOURNE HILLS CIVIC ASSOC.
JOHN R. DONOHUE
9 KEATS DRIVE
CLAYMONT, DE. 19703

RUSSEL J. BROWN
WILLOW RUN CIVIC ASSOC
1110 MONTGOMERY RD.
ELSMERE
WILMINGTON, DE 19805

BELLEVUE MANOR MAINTENANCE CORP.
LEO J. HOLTERMAN
608 GREENFIELD PLACE
WILMINGTON, DE. 19809

CIVIC ORG, NEW CASTLE COUNTY

BESTFIELD CIVIC ASSOCIATION
ROBERT P. VANDEGRIFT
604 WALNUT ST.
WILMINGTON, DE. 19804

BRACK-EX-ROSELLE CIVIC ASSOC.
ROBERT T. WISNIEWSKI
13 LEHIGH AVE, ROSELLE
WILMINGTON, DE. 19805

BRANDYWINE HILLS COMMUNITY ASSOC.
STANLEY T. CZAJOWSKI
4006 COLERIDGE ROAD
WILMINGTON, DE. 19802

BRECKS LANE ASSOC.
THEODORE H. ASHFORD
194 1/2 BRECK'S LANE
WILMINGTON, DE. 19807

BROOKHAVEN CIVIC ASSOC
MRS. EMMA JEAN LYNCH
63 GREEN RIDGE ROAD
NEWARK, DE. 19711

BROOKSIDE COMMUNITY, INC.
900 MARROWS ROAD
NEWARK, DE. 19711

CIVIC LEAGUE FOR NEW CASTLE CTY.
MRS. MILTON J. ROEDEL
6 CRESTFIELD RD., CRESFIELD
WILMINGTON, DE. 19810

BIRCHWOOD PARK CIVIC ASSOC.
JOHN L. CLEMENS
1105 RALPH ROAD, FOXCHASE
NEWARK, DE. 19711

BOULDER BROOK CIVIC ASSOC.
CHARLES O. HANSSMAN
3 BOULDER BROOK ROAD
WILMINGTON, DE. 19803

BRANDYWOOD CIVIC ASSOC.
ALVIN J. FLINT
2120 BRANDYWINE DRIVE
WILMINGTON, DE. 19810

BROOKDALE FARM CIVIC ASSOC.
MR. JOHN KINTELL
614 BURNHAVEN LANE
WILMINGTON, DE. 19808

BROOKLAND TERRACE CIVIC ASSOC.
FRANCIS FLEISCHUT
107 ARMSTRONG AVE.
WILMINGTON, DE. 19805

BROOKMEND CIVIC ASSOC.
JOSEPH H. COHREN
51 QUEENS WAY
NEWARK, DE. 19711

CIVIC LEAGUE FOR NEW CASTLE CTY.
MR. EUGENE J. LIPSTEIN, PRES.
704 W. MATTSON RUN PARKWAY
WILMINGTON, DE. 19803

CIVIC ORG. NEW CASTLE COUNTY

CIVIC LEAGUE FOR NEW CASTLE CTY.
MRS. HENRY AUGHEY
2002 SHERWOOD ROAD
WILMINGTON, DE. 19810

COUNCIL OF CIVIC ORGANIZATIONS
OF BRANDYWINE HUNDRED
WARREN R. BECK
2004 MARKIN ROAD, GRAYLYN CREST
WILMINGTON, DE. 19803

CANTERBURY HILLS CIVIC ASSOC.
WILSON HECKER
108 SHEFFIELD DRIVE
HOCKESSIN, DE. 19707

CARRCROFT CIVIC ASSOC.
DONALD D. SLY
809 BRENTWOOD DRIVE
WILMINGTON, DE. 19803

CEDAR CREST CIVIC ASSOC.
KENNETH A. JEFFERY
2417 EAST PARRIS DRIVE
WILMINGTON, DE. 19808

CHALFONTE CIVIC ASSOC.
HAROLD J. WEISS
2410 BERWYN ROAD
WILMINGTON, DE. 19810

CHAPELCROFT CIVIC ASSOC.
RONALD MUSHINSKY
23 AUSTIN ROAD
WILMINGTON, DE. 19810

CIVIC COUNCIL FOR COUNTY DEVE.
MR. JAMES STEPLER
14 CLYDE CIRCLE
NEW CASTLE, DE. 19720

CANBY PARK CIVIC ASSOC.
FREDERICK J. BAUM
1923 SENECA DRIVE
WILMINGTON, DE. 19805

CARDIFF CIVIC ASSOC.
NICHOLAS J. PANZETTA
3215 ROMILLY ROAD
WILMINGTON, DE. 19810

CASTLE HILLS CIVIC ASSOC.
MRS. CLIFFORD DOOLING
35 CASTLE HILLS DRIVE
NEW CASTLE, DE. 19720

CEDARS COMMUNITY CLUB
MRS. ARTHUR BAUM
2311 NEWPORT GAP PIKE
WILMINGTON, DE. 19808

CHANNIN CIVIC ASSOC.
ROBERT BURKE
2400 HAMMLEWOOD DRIVE
WILMINGTON, DE. 19810

CHAPEL HILL CIVIC ASSOC.
WALTER BINKLEY
13 HIDEN DRIVE
NEWARK, DE. 19711

CIVIC ORG. NEW CASTLE COUNTY

CHATHAM CIVIC ASSOC.
RALPH LIGHTER
118 GRAYLYN ROAD
WILMINGTON, DE. 19803

CHESTNUT HILL ESTATES CIVIC ASSOC.
P.O. BOX 595
NEWARK, DE. 19711

CLELAND HEIGHTS CIVIC ASSOC.
FRANK MORABITO
1155 SOUTH CLAYTON ROAD
WILMINGTON, DE. 19804

CONCORD HILLS CIVIC ASSOC.
PAUL H. HOYER
5 CUMEE CIRCLE
WILMINGTON, DE. 19803

COVERED BRIDGE FARMS CIVIC ASSOC.
LAWRENCE L. MOISE II
27 CARRIAGE LANE
NEWARK, DE. 19711

CROSSGATES CIVIC ASSOC.
GERALD SCARAN
2524 MILL CREEK ROAD
WILMINGTON, DE. 19808

MR. NATHANIEL O. WEBB, CHAIRMAN
CITIZEN ADVISORY COMMITTEE TO MAYO
713 WEST 2ND STREET
WILMINGTON, DE 19801

CHEROKEE WOODS CIVIC ASSOC.
MARSHALL H. BAKER
26 CHEROKEE DRIVE
NEWARK, DE. 19711

CHRISTINE MANOR CIVIC ASSOC.
EDWARD L. CAIRNS
104 JACKSON HALL SCHOOL ROAD
NEWARK, DE. 19711

COLLINS PARK COMMUNITY ASSOC.
KENNETH BOULDEN, JR.
123 ATLAS DRIVE
NEW CASTLE, DE. 19720

COOCH'S BRIDGE CIVIC ASSOC.
MR. DWIGHT A. HOLTZEN
R. D. #2
OLD BALTIMORE PIKE
NEWARK, DE. 19711

CHESTFIELD CIVIC ASSOC.
GEORGE H. CASSEDY
4 CRESTFIELD ROAD
WILMINGTON, DE. 19810

CLAYMONT HEIGHTS CIVIC ASSOC.
ELMER MORGAN
2301 MCKINLEY AVE.
CLAYMONT, DE. 19703

REV. REGINALD MERCER, CHAIRMAN
CITY PLANNING COMMISSION
C/O DEPT. OF PLANNING & DEVELOPMA
ROOM 358, PUBLIC BLDG
WILMINGTON, DE. 19801

CIVIC ORG, NEW CASTLE COUNTY

DE LA WARR COUNCIL
MR. DAVID GREEN
105 PARMA AVE
OVERVIEW GARDENS
NEW CASTLE, DE. 19720

J.H. TYLER MCCONNELL
DELAWARE TRUST CO.
WILMINGTON, DEL. 19899

DAWLEY WOODS CIVIC ASSOC.
PAUL STEVENS
1019 TWEEDBROOK ROAD
WILMINGTON, DE. 19810

DARTMOUTH WOODS CIVIC ASSOC.
ROBERT E. SCHLUSSER
13 LANTERN LANE
WILMINGTON, DE. 19810

DEACON'S WALK CIVIC ASSOC.
BRUCE DAVIDSON
39 VANSANT ROAD
NEWARK, DE. 19711

DEERHURST CIVIC ASSOC.
JOHN C. BREY
211 PIERCE ROAD
WILMINGTON, DE. 19803

DELPARK MANOR CIVIC ASSOC.
JOHN S. CARATOS
4705 OLD CAPITOL TRAIL
WILMINGTON, DE. 19808

DELWYNN COMMUNITY
HERBERT S. WHY, JR.
3201 DELWYNN DRIVE
WILMINGTON, DE. 19803

DEVON CIVIC ASSOC.
COLEMEN F. METZLER
3346 MORNINGSIDE ROAD
WILMINGTON, DE. 19803

DEVONSHIRE CIVIC ASSOC.
STEPHEN GROSS
3320 ROCKFIELD DRIVE
WILMINGTON, DE. 19810

DRUMMOND NORTH CIVIC ASSOC.
R.W. DIVELER
19 DENNISON ROAD
NEWARK, DE. 19711

DUNLEITH CIVIC ASSOC.
DANIEL PIERCE
411 ROBINSON DRIVE
WILMINGTON, DE. 19801

DUNLINDEN CIVIC ASSOC.
JOHN C. BAKER
105 ST. JOHN DRIVE
WILMINGTON, DE. 19808

DARLEY CIVIC ASSOC.
GUY WEBSTER
24 INDIAN FIELD ROAD
WILMINGTON, DE. 19810

CIVIC ORG, NEW CASTLE COUNTY

EAGLE GLEN CIVIC ASSOC.
TERRY L. INWOOD
11 ANTIOCH COURT
NEW CASTLE, DE. 19720

ELEUTH. MILLS-HAGLEY FOUND
EDUC.-GUIDES OFF AT MUSEUM
GREENVILLE, DE. 19807

FOULK WOODS CIVIC ASSOC.
W.F. BRUNDYKE
2645 LONGWOOD DRIVE
WILMINGTON, DEL. 19810

FOULKSIDE CIVIC ASSOC.
HERBERT MITCHELL
1801 GREEN LANE
WILMINGTON, DEL. 19810

FOUR SEASONS CIVIC ASSOC.
ARTHUR BROOKS
3 LEAFY LANE
NEWARK, DEL. 19711

JAMES ASSIMOS
EXECUTIVE CLUB
9TH & SHIPLEY STS
WILMINGTON, DE. 19801

MR DOUG FARISS
GR SW CIVIC COUNCIL
PO BOX 3168
NEWPORT, DE 19804

GREATER SOUTHWEST CIVIC COUNCIL
MR. JAMES D FARISS, JR.
P.O. BOX 3168
NEWPORT
WILMINGTON, DE. 19804

GEORGIAN TERRACE CIVIC ASSOC.
RALPH H. ELLIOTT
526 RUXTON DRIVE
WILMINGTON, DEL. 19809

GLEN BERNE CIVIC ASSOC.
MRS. GEORGE CIUFFETELLI
207 ROTHWELL DRIVE
WILMINGTON, DEL. 19809

GLENDALE CIVIC ASSOC.
SAMUEL H. FOX, JR.
22 W. CLAIRMOUNT DRIVE
NEWARK, DEL. 19711

GREENBRIDGE CIVIC ASSOC.
JOSEPH FISONA
24 GREENBRIDGE DRIVE
NEWARK, DEL. 19711

GREEN MEADOW CIVIC ASSOC.
JAMES W. SEARCY
830 MONTICH ROAD
WILMINGTON, DEL. 19803

GREEN TREE CIVIC ASSOC.
W. ROBERT SCHNUDER
705 APPLETREE COURT
CLAYMONT, DEL. 19703

CIVIC ORG, NEW CASTLE COUNTY

GREENVIEW CIVIC ASSOC.
WILLARD ASHMORE
3301 CROSS COUNTRY DRIVE
WILMINGTON, DEL. 19810

GREATER HOCKESSIN AREA DEVE. AS.
JOHN DRYSDALE
R.D. 2, BOX 295
HOCKESSIN, DEL. 19707

GLENVILLE CIVIC ASSOC.
JOHN T. MATISKO
53 EAST NETHERFIELD ROAD
WILMINGTON, DEL. 19804

GRAYLIN CREST CIVIC ASSOC.
JOHN W. COLLETTE
1235 FAUN ROAD
WILMINGTON, DEL. 19803

GTR. NEWARK CHAMBER OF COMM.
250 E. MAIN ST.
NEWARK, DE. 19711

HISTORICAL SOCIETY OF DELAWARE
505 MARKET ST.
WILM., DEL. 19801

HAMILTON PARK CIVIC ASSOC.
MRS. FRANK FROM
18 SOUTH STREET
NEW CASTLE, DEL. 19720

GRINHURST CIVIC ASSOC.
WILLIAM J. MILLER
26 GEORGETOWN AVE.
WILMINGTON, DEL. 19809

DIRECTOR
GREATER WILMINGTON DEVEL. COUNCIL
300 DELAWARE AVENUE
WILMINGTON, DE. 19801

GUNDY ESTATES CIVIC ASSOC.
MRS. DOLORES J. NASH
400 BALSAM TERRACE
WILMINGTON, DEL. 19804

GREEN ACRES CIVIC ASSOC.
PAUL F. DUNSON, JR.
1226 GRINNELL ROAD
WILMINGTON, DEL. 19803

HOCKESSIN, GREATER AREA
DEVELOPMENT ASSOCIATION
MR. JAMES TARRELL
R.D. # 2, BOX 347
HOCKESSIN, DE. 19707

HUMAN SERVICES COUNCIL
HUMAN SERVICES DEPT.
P.O. BOX 390
NEWARK, DE. 19711

HARMONY HILLS CIVIC ASSOC.
VANCE THORPE
519 TAMARA CIRCLE
NEWARK, DEL. 19711

CIVIC ORG, NEW CASTLE COUNTY

HEATHERBROOKE CIVIC ASSOC.
EDMUND MERRIMAN
2414 HEATHER ROAD WEST
WILMINGTON, DEL. 19803

HERITAGE-GRENDON CIVIC ASSOC.
P.O. BOX 5064
WILMINGTON, DEL. 19808

HILLSIDE CIVIC ASSOC.
MARK CAMERSON
109 ROSEWOOD DRIVE, HILLSIDE
NEWARK, DEL. 19711

HOLLINGSWORTH TRACT CIVIC ASSOC.
GEORGE FORD
23 MT. AIRY DRIVE, CENTERVILLE
WILMINGTON, DEL. 19807

KENNETT PIKE ASSOCIATION
MR. ROBERT H. BOLLING, JR., PRES.
BOX 3592
GREENVILLE
WILMINGTON, DE. 19807

KIRKMOOR AREA CIVIC ASSOC.
PETER ROOKER
130 PHYLLIS DRIVE, NEWKIRK EST.
NEWARK, DEL. 19711

KNOLLWOOD CIVIC ASSOC.
ROBERT F. BYRNE
32 COLBY AVENUE
CLAYMONT, DEL. 19703

HENDERSON HEIGHTS CIVIC ASSOC.
JOHN COLE
23 HENDERSON HILL ROAD
NEWARK, DEL. 19711

HILLS OF SKYLINE CIVIC ASSOC.
CHARLES H. PETERSON
3002 RIDGEVALE ROAD
WILMINGTON, DEL. 19808

HILLTOP MANOR CIVIC ASSOC.
RICHARD WEAVER
108 MULLIN ROAD
WILMINGTON, DEL. 19809

HOLLY OAK TERRACE
ROGER DEMEASIO
205 CLEARVIEW AVENUE
WILMINGTON, DEL. 19809

KINGSBRIDGE CIVIC ASSOC.
DONALD R. MUSSELMAN
3 CROWN COURT
WILMINGTON, DEL. 19810

KIRKWOOD GARDENS CIVIC ASSOC.
CHARLES MANCHESTER
2302 HAMMOND PLACE
WILMINGTON, DEL. 19808

KENNETT PIKE ASSOC.
P.O. BOX 3592, GREENVILLE
WILMINGTON, DEL. 19807

CIVIC ORG. NEW CASTLE COUNTY

MIAMENSI CIVIC ASSOC.
P.O. BOX 6126
WILMINGTON, DEL. 19804

LEAGUE OF WOMEN VOTERS
OF GREATER WILMINGTON
719 SHIPLEY ST.
WILMINGTON, DE 19801

LONGVIEW FARMS CIVIC ASSOC.
MRS. CHARLES WILKIN
1113 N. OVERHILL COURT
WILMINGTON, DEL. 19810

LANCASHIRE CIVIC ASSOC.
MR. JOHN CARLSON
2402 DACIA DRIVE
WILMINGTON, DEL. 19803

LIMESTONE ACRES MAINTENANCE CORP.
LARRY C. LAPPLE
4834 HAILEY DRIVE
WILMINGTON, DEL. 19808

LINDEN HEATH CIVIC ASSOC.
DOUGLAS ELLIOTT
4415 PENNINGTON COURT
WILMINGTON, DEL. 19808

LLANGOLLEN CLUB, INC.
EDWARD M. WISH
209 ROLLING GREEN AVE.
LLANGOLLEN ESTATES
NEW CASTLE, DEL. 19720

KIMBERTON
THOMAS DELUZIO
40 FLEMING STREET
NEWARK, DEL. 19711

LOWER NEW CASTLE CTY. CITIZENS
ASSN.
JOSEF A. HUNGER, PRES.
P.O. BOX 419
MIDDLETOWN, DE. 19709

LONGWOOD CIVIC ASSOC.
HEINZ LINKE
3324 ENGLEWOOD ROAD
WILMINGTON, DEL. 19810

LIFTWOOD ASSOC.
HARRY LADD
305 HARKER AVE.
WILMINGTON, DEL. 19803

LINDAMERE ASSOC.
NEWELL HIGELOW
207 SOUTH ROAD
WILMINGTON, DEL. 19809

LINDEN HILL CIVIC ASSOC.
JOSEPH KELLY
3 PAGE PLACE
WILMINGTON, DEL. 19808

LOG RUN CIVIC ASSOC.
WESLEY BRONG
1836 SAWMILL DRIVE
WILMINGTON, DEL. 19810

CIVIC ORG. NEW CASTLE COUNTY

MILL CK. HUND. COUNCIL CIVIC ORG.
JOHN ROWE
4628 LAURA DR., MANETTE HTS.
WILMINGTON, DE. 19808

MARAROD MEADOWS CIVIC ASSOC.
JACK HITCH
15 ROWSIN DRIVE
NEWARK, DEL. 19711

MCDANIEL CIVIC ASSOC.
P.O. BOX 7075
TALLEYVILLE
WILMINGTON, DEL. 19803

MINQUADALE CIVIC ASSOC.
ROBERT J. MOORE, JR.
18 W. HAZELDALE AVENUE
NEW CASTLE, DEL. 19720

REV. JAMES M. YOUNG
METH. ACTION PROGRAM
407 WEST 9TH STREET
WILMINGTON, DE. 19801

NEWARK LEAGUE OF WOMEN VOTERS
MRS. MARY M. JOENS, PRES.
44 CORNWALL DRIVE
DEVON
NEWARK, DE. 19711

NORTHMINSTER CIVIC ASSOC.
MR. MIKE HOLO
117 BROADMENT ROAD
WILMINGTON, DE. 19810

MAPLECREST CIVIC ASSOC.
JOHN CRISHOCK
2413 E. ERIC DRIVE
WILMINGTON, DEL. 19808

MAYFIELD CIVIC ASSOC.
J. HALSEY
1610 WALTON ROAD
WILMINGTON, DEL. 19803

MEADOWOOD CIVIC ASSOC.
DAVID TIMMING
108 FORSYTHIA DRIVE
NEWARK, DEL. 19711

MONTCLARE CIVIC ASSOC.
LEE BAUM
2606 SALEM DRIVE
WILMINGTON, DEL. 19808

N. MILL CREEK HND. ASSN., INC.
ROBERT C. BOWMAN
704 AMBLESIDE DR., WESTMINISTER
WILMINGTON, DE. 19808

NORMANDY MANOR CIVIC ASSOC.
ROBERT SMILEY
1103 NORHEE DRIVE
WILMINGTON, DEL. 19803

NORTHRIDGE CIVIC ASSOC.
MIKE O'NEIL
921 PARKSIDE BOULEVARD
CLAYMONT, DEL. 19703

CIVIC ORG. NEW CASTLE COUNTY

NORTH STAR CIVIC ASSOC.
JOHN MATT
110 NEPTUNE DRIVE
NEWARK, DEL. 19711

NAACP
ROOSEVELT FRANKLIN, PRES.
107 EAST 9TH ST.
WILMINGTON, DE. 19801

OAKCREST CIVIC ASSOC.
WAYNE MARTHON
2119 LARGO ROAD
WILMINGTON, DEL. 19803

OAKMONT CIVIC ASSOC.
CLYDE KNOTTS
32 MINNSHIRE ROAD
NEW CASTLE, DEL. 19720

PIKE CREEK CIVIC LEAGUE
MR. ROBERT J. SCHACHT, PRES.
3 HOLT ROAD
DRUMMOND HILL
NEWARK, DE. 19711

PEMBREY CIVIC ASSOC.
JACK D. CLINCH
209 N. PEMBREY DRIVE
WILMINGTON, DEL. 19803

PENN ACRES CIVIC ASSOC.
P.O. BOX ROA
NEW CASTLE, DEL. 19720

NORTHWOOD CIVIC ASSOC.
PAUL KNIGHT
403 MARSHFIELD ROAD
WILMINGTON, DEL. 19803

NORTH MILL CREEK ASSOC.
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HOCKESSIN, DE. 19707

OAK LANE MANOR CIVIC ASSOC.
DONALD JOHNSON
1005 S. HILTON ROAD
WILMINGTON, DEL. 19803

OLD MILL MANOR CIVIC
P.O. BOX 864
NEWARK, DEL. 19711

PIKE CREEK CIVIC LEAGUE
FRITZ CRIESINGER
3013 RIDGEVALE ROAD
HILLS OF SKYLINE
WILMINGTON, DE. 19808

PENARTH CIVIC ASSOC.
ROBERT MORROW, JR.
1702 PAXON DRIVE
WILMINGTON, DEL. 19803

PENNROCK CIVIC ASSOC.
MRS. FRED STONESIFER
509 WYOMING AVENUE
WILMINGTON, DEL. 19809

CIVIC ORG. NEW CASTLE COUNTY

PENN-ROSE CIVIC ASSOC.
RAWLINS MINNER
115 E. 41ST STREET
WILMINGTON, DEL. 19802

POLLY DRUMMOND HILL CIVIC ASSOC.
ROBERT READ
R.D. #3
NEWARK, DEL. 19711

PINE CREST CIVIC ASSOC.
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WILMINGTON, DE.

MRS. ANN CUCCU
ROSELLE-BRACK-EX CIVIC ASSOCIATION
5 BRIGHTON AVE., BRACK-EX
WILMINGTON, DE 19805

RAMBLETON ACRES CIVIC ASSOC.
ROBERT C. CLOSSEN
8 STEVENS AVENUE
NEW CASTLE, DEL. 19720

RED CREEK ACRES CIVIC ASSOC.
EUGENE E. MIKLASIEWICZ
12 PETRO DRIVE
WILMINGTON, DEL. 19804

RED MILL FARMS CIVIC ASSOC.
JOHN TOWER
20 CONDELE ROAD
NEWARK, DEL. 19711

PERTH CIVIC ASSOC.
ROBERT W. NORRIS
12 PERTH DRIVE
WILMINGTON, DEL. 19803

PENNCREW MANOR CIVIC ASSOC.
ROBERT J. LEONZIO
2256 ST. JAMES DR.
WILMINGTON, DE. 19808

G. RUTZ
ROSELLE-BRACK-EX CIVIC ASSOCIATIC
26 N. WOODWARD, ROSELLE
WILMINGTON, DE 19805

ROBERT WISNIWIUWSKI
ROSELLE-BRACK-EX CIVIC ASSOCIATIC
13 LEHIGH AVE., ROSELLE
WILMINGTON, DE 19805

RAMBLEWOOD CIVIC ASSOC.
WILLIAM R. VAN NOTE
1020 TIMBERWYCK ROAD
WILMINGTON, DEL. 19810

RED LION CIVIC ASSOC.
GLENN PUSEY
R.D., RED LION
BEAR, DEL. 19701

ROMSCOTT MANOR CIVIC ASSOC.
JOHN E. CATER
7 CORDNEY ROAD
NEWARK, DEL. 19711

CIVIC ORG. NEW CASTLE COUNTY

ROCKWOOD HILLS CIVIC ASSOC
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4626 SYLVANUS DRIVE
WILMINGTON, DEL. 19803

ROSEHILL GARDENS CIVIC ASSOC.
MRS. HARVEY KING
189 RYAN AVENUE
NEW CASTLE, DEL. 19720

RUTHERFORD CIVIC ASSOC.
BEN DEMODA
106 PATRICIA ROAD
NEWARK, DEL. 19711

SCOTTFIELD CIVIC ASSOC.
TED MANNO
233 GARFIELD DRIVE
NEWARK, DEL. 19711

SHARPLEY CIVIC ASSOC.
ROBERT E. CATES
610 WHITBY DRIVE
WILMINGTON, DEL. 19803

SHELLY FARMS CIVIC ASSOC.
WARREN CLARK
15 LYRIC DRIVE
NEWARK, DEL. 19711

SHIPLEY HEIGHTS CIVIC ASSOC.
OLIVER W. CRICHTON
96 COLDWOOD AVENUE
WILMINGTON, DEL. 19803

ROSEGATE CIVIC ASSOC.
MRS. ODESSA RIDER
43 THORN LANE
NEW CASTLE, DEL. 19720

ROSEVILLE PARK CIVIC ASSOC.
JAMES FLYNN
2 MAPLE AVENUE
NEWARK, DEL. 19711

ROSER FARMS CIVIC ASSOC.
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SEDGELY FARMS CIVIC ASSOC.
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4907 THREADNEEDLE ROAD
WILMINGTON, DEL. 19807

SHELLBURNE CIVIC ASSOC.
HENRY BLACK
55 PASCHALL ROAD
WILMINGTON, DEL. 19803

SHERWOOD PARK II CIVIC ASSOC.
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1116 MCKENNAN'S CHURCH ROAD
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CIVIC ORG. NEW CASTLE COUNTY

SPRING VALLEY CIVIC ASSOC.
MRS. JAMES FURSTNER
27 N. SPRING VALLEY ROAD
WILMINGTON, DEL. 19807

STRATFORD CIVIC ASSOC.
TERRY SPENCE
26 FREEPORT ROAD
NEW CASTLE, DEL. 19720

SWANWYCK ESTATES CIVIC ASSOC.
FRANK ROBERTS
111 CROSS AVENUE
NEW CASTLE, DEL. 19720

TODD ESTATES CIVIC ASSOC.
DONALD M. IRONSIDE
134 LYNCH FARM DR.
NEWARK, DE. 19711

TALLEYBROOK CIVIC ASSOC.
JOHN MARTIN
2827 KENNEDY RD.
WILMINGTON, DE. 19810

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708 BURNLEY RD.
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CLAYMONT, DE. 19703

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CLARENCE WALLS
11 HARBESON PLACE
WILMINGTON, DEL. 19804

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WILMINGTON, DEL. 19810

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ROBERT A. OAKES
614 S. BROWNLEAF RD.
NEWARK, DE. 19711

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DONALD HOWAT
4603 TALLEY HILL LANE
WILMINGTON, DE. 19803

TARLETON CIVIC ASSOC.
JAMES W. HYLAND
3102 WILMONT DR.
WILMINGTON, DE. 19810

TERRACE MANOR GARDENS CIVIC ASSOC.
ALTON W. GRAHAM
305 THIRD ST., HOLLOWAY TERR.
NEW CASTLE, DE. 19720

VARLAND VILLAGE CIVIC ASSOC.
DREW YEAGER
28 OAKES DR.
NEWARK, DE. 19711

CIVIC ORG. NEW CASTLE COUNTY

VILLAGE OF DRUMMOND HILL CIVIC
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JON DUFRESNE
13 MCMECHEN RD.
NEWARK, DE. 19711

J GREIGG
WILLOW RUN & 141 COALITION
1624 W. WILLOW RUN DR.
WILLOW RUN
WILMINGTON, DE 19805

R. WAYNE ASHBEE
WOODLAND HEIGHTS CIVIC ASSOCIATION
1001 WAGONER DR.
WILMINGTON, DE 19805

JAMES FOREST
WOODLAND PARK CIVIC ASSOCIATION
2016 WILDWOOD DR
WILMINGTON, DE 19805

FRED T. O'DONNELL
WILM. SAVINGS FUND SOCIETY
WILMINGTON, DEL. 19899

MR. JOHN STUCKING
WOODLAWN TRUSTEES, INC.
2201 W. 11 TH ST.
WILMINGTON, DE. 19802

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2600 CAPITOL TRAIL
NEWARK, DE. 19711

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703 COVERDALE RD.
WILMINGTON, DE. 19805

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1405 JAN DR.
WILMINGTON, DE. 19803

WELSHIRE CIVIC ASSOC.
ALAN S. JONES
2 WELLINGTON RD.
WILMINGTON, DE. 19803

WESTGATE FARMS CIVIC ASSOC.
JOHN SANIEZO
113 WESTGATE DR.
WILMINGTON, DE. 19808

WESTHAVEN CIVIC ASSOC.
MICHAEL TURNER
8 WILLING WAY
WILMINGTON, DE. 19807

WESTMINSTER CIVIC ASSOC.
DONALD A. NELSON
601 ENTWISLER COURT
WILMINGTON, DE 19808

WESTVIEW CIVIC ASSOC.
JAMES WRIGHTSON
311 ATKINSON DR.
WILMINGTON, DEL. 19804

CIVIC ORG. NEW CASTLE COUNTY

WESTWOOD-FORWOOD CIVIC ASSOC.
MANUEL ESAVIAN
2011 FERNDALE DR., WESTWOOD
WILMINGTON, DE. 19810

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EDWARD D. SCOTT
122 DUNSONNE DR.
NEW CASTLE, DE. 19720

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WILLIAM RICHARD GREEN
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WILMINGTON, DE. 19805

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NEW CASTLE, DE. 19720

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104 HANBURY DR.
WILMINGTON, DE. 19803

WINDYRUSH CIVIC ASSOC.
CHARLES HOUGHTON
116 CHATHAM PLACE
WILMINGTON, DE. 19810

WOODBINE CIVIC ASSOC.
MRS. PATRICIA SOFI
3019 MAPLE SHADE LANE
WILMINGTON, DE. 19810

WOODBROOK CIVIC ASSOC.
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404 FOULKSTONE RD.
WILMINGTON, DE. 19803

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WILMINGTON, DE. 19804

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WILMINGTON, DE 19805

WOODLAND PARK CIVIC ASSOC.
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WILMINGTON, DE. 19805

WOODSHADE CIVIC ASSOC.
WALTER J. KOVALEVICH
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NEWARK, DE. 19711

WOODSIDE HILLS CIVIC ASSOC.
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WILMINGTON, DE. 19809

WYCLIFFE CIVIC ASSOC.
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17 N. CLIFFE DRIVE
WILMINGTON, DE. 19809

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908 KING ST.
WILMINGTON, DE. 19801

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CAMDEN, NJ 08103

PRESIDENT, PENNSAUKEN BETTERMENT
CIVIC ASSOCIATION
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PENNSAUKEN, NJ 08109

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WEST CHESTER, PA 19380

WHITE CLAY WATERSHED ASSOC.
MS. GWEN CRAMER
SOUTH BANK ROAD
LANDENBERG, PA. 19350

ASTON TWP. BUSINESSMENS ASSOC.
BOX 85
ASTON, PA. 19014

ASTON TWP. LIONS CLUB
BOX 52
ASTON, PA. 19014

CENTRAL YMCA
2 S. EYRE DR.
CHESTER, PA. 19013

CITIZENS COUNCIL OF DELAWARE
COUNTY
103 N. JACKSON ST.
MEDIA, PA. 19063

COMMUNITY SERVICE CENTER
151 W. 5TH ST.
CHESTER, PA. 19013

DELAWARE COUNTY CHILD CARE SERVICE
151 W. 5TH & PENN STS.
CHESTER, PA. 19013

GREATER CHESTER MOVEMENT DAY CARE
CENTER
145 W. 5TH ST.
CHESTER, PA. 19013

CIVIC ORG. DELAWARE COUNTY

DELAWARE COUNTY CHAMBER OF COMMER.
6 E. BALTIMORE PIKE
MEDIA, PA. 19063

DEL & CHES CO. REGIONAL COUNCIL
BOX 35
THORNTON, PA. 19373

DELCO WELFARE RIGHTS ORGANIZATION
433 W. 3RD ST.
CHESTER, PA. 19013

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PO BOX P
SWARTHMORE, PA 19081

FIRST DELAWARE COUNTY JAYCEES
BOX 6
CHESTER, PA. 19013

FRANK KINTZLER
HIGH POINT ACRES COMMUNITY ASSN
ERIC LANE
GLEN RIDDLE, PA. 19037

H. ALLEN DAVIS JR., CHMN.
MIDDLETOWN TWP. CIVIC GROUPS COUN.
BOX 215
LIMA, PA. 19060

NORTH CENTRAL PROJECT AREA
COMMITTEE
1430 W . 7TH ST.
CHESTER, PA. 19013

D. COOKE
OLD FORGE & ARBOR VIEW AREA CIVIC
ASSN.
12 HORSESHOE DR.
MEDIA, PA. 19063

PRACTICAL NURSING PROGRAM
147 W 5TH ST.
CHESTER, PA. 19013

JOSEPH H. TYSON
SOUTHEAST DELCO LIONS INTL
345 W. 21ST. ST.
CHESTER, PA. 19013

R.E. BAINBRIDGE
SWARTHMORE WALLINGFORD JAYCEES
4 HIGHPOINT DRIVE
GLEN RIDDLE, PA. 19037

TOBY FARMS CIVIC ASSOC.
THOMAS H. MULLIN, DIRECTOR
1605 POWELL RD.
BROOKHAVEN, PA. 19015

UNITED WAY OF SOUTHEAST DELCO
930 AVE. OF THE STATES
CHESTER, PA. 19013

CIVIC ORG. MONTGOMERY CO.

PERKIOMEN VALLEY WATERSHED ASSOC.
P.O. BOX 55
SCHWENKSVILLE, PA 19473

STONY CREEK CITIZENS GROUP
527 SWEDE ST.
NORRISTOWN, PA 19407

ROXBOROUGH-MANAYUNK-WISSAHICKON
HISTORICAL SOCIETY
6134 RIDGE AVENUE
ROXBOROUGH, PA

PRESIDENT
AMERICAN CAMPING ASSOCIATION, INC.
BRADFORD WOODS
MARTINSVILLE, IN 46151

PRESIDENT
THE GARDEN CLUB OF AMERICA
598 MADISON AVENUE
NEW YORK, NY 10022

CONSERVATION AND ENVIRONMENTAL INTERESTS

DELAWARE CITIZENS FOR CLEAN AIR
DELAWARE TB AND HEALTH SOCIETY
1308 DELAWARE AVENUE
WILMINGTON, DE 19806

DELAWARE FED. OF GARDEN CLUBS
P.O. BOX 216
CLAYMONT, DE 19703

DELAWARE MUSEUM OF NATURAL HISTORY
BOX 3937
GREENVILLE, DE 19807

DEL. SHELL FISHERIES COMMISSION
COUNCIL OF SHELL FISHERIES
NATURAL RESOURCES BUILDING
DOVER, DE 19901

DELAWARE WILDLIFE FEDERATION
RD 1 BOX 286
SMYRNA, DE 19977

DIAMOND STATE HUNT AND FISH CLUB
17 UTAH ROAD
WILMINGTON, DE 19808

DUCKS UNLIMITED
DELAWARE CHAPTER
813 AUGUSTA ST.
WILMINGTON, DE 19807

DU PONT FISH AND GAME ASSOCIATION
ENGINEERING DEPARTMENT
DU PONT CO.
WILMINGTON, DE 19898

CON. & ENV. DELAWARE STATE

FORWARD LANDS, INC.
810 BLACKSHIRE RD.
WILMINGTON, DE. 19805

SIERRA CLUB
2637 MAJESTIC DRIVE
WILMINGTON, DE 19803

DOROTHY P MILLER
DELAWARE GROUP,SIERRA CLUB
430 ORCHARD ROAD
NEWARK, DE 19711

SOCIETY OF NATURAL HISTORY OF DEL
R.D. 1, BOX 137
HOCKESSIN, DE 19707

SPORTSMANS CONSERVATION CLUB
2612 MC KINLEY AVE.
CLAYMONT HEIGHTS, DE 19703

STATE COMM. FOR CLEANER AIR WEEK
14 ASHLEY PLACES
WILMINGTON, DE 19804

STUDENT COALITION FOR ENVIRONMENT
ROOM 107, STUDENT CENTER
UNIVERSITY OF DELAWARE
NEWARK, DE 19711

MR. EDMUND HARVEY
DELAWARE WILD LANDS COMMITTEE
5806 KENNETT PIKE
WILMINGTON, DELA. 19807

COALITION FOR NATURAL STREAM
VALLEYS
C/O MS. DOROTHY MILLER
430 ORCHARD ROAD
NEWARK, DE. 19711

CHRISTINA RIVER ECOLOGICAL EFFORT
COMMITTEE (CREEK)
PRESIDENT
928 QUAIL LANE
PHEASANT RUN
NEWARK, DE. 19711

DELAWARE RECREATION & PARKS
SOCIETY
PRESIDENT
C/O RECREATION PROMOTION SERVICES
1307 ORANGE ST
WILMINGTON, DE. 19801

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EXECUTIVE DIRECTOR
BOX 3900
WILMINGTON, DE. 19807

EXECUTIVE DIRECTOR
DEL. NATURE EDUCATION CTR.
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GEORGE SHILLING, JR.
38 DUNCASTON ROAD
NEW CASTLE, DE. 19720

CON. & ENV. NEW CASTLE COUNTY

FORT DELAWARE SOCIETY
P.O. BOX 1251
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2616 KIMBROUGH DRIVE
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32 WAYNE DRIVE
WILMINGTON, DE. 19809

WILMINGTON TRAIL CLUB
2009 N. VAN BUREN ST.
WILMINGTON, DE 19802

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JOHN STENGER ENVIRONMENTAL INST.
LEWES, DELA. 19958

HISTORIC RED CLAY VALLEY
L. J. SCHEVERMAN, TREAS.
308 SHARPLEY ROAD
WILMINGTON, DE. 19803

LEAGUE OF WOMEN VOTERS
C/O MS. BETTY HUTCHINSON
311 APPLE ROAD
NEWARK, DE. 19711

SOCIETY OF NATURAL HISTORY OF
DELAWARE
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THOMPSONS BEACH NJ 08324

CHAIRMAN
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PRINCETON UNIVERSITY
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OLDMANS CREEK WATERSHED ASSOC.
PEDRICKTOWN, NJ. 08067

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JOINT LEGISLATIVE AIR AND WATER
POLLUTION CONTROL AND
CONSERVATION COMMITTEE
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CAPITOL BUILDING
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CON. & ENV. PENNSYLVANIA STATE

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SPORTSMENS CLUBS, INC.
925 SOUTH JEFFERSON STREET
JEANNETTE, PA 15644

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PENNSYLVANIA DIVISION
319 SUNSET ROAD
WEST READING, PA 19602

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8TH DAY PRIDE
BUCKS COUNTY COMMUNITY COLLEGE
SWAMP ROAD
NEWTOWN, PA 18940

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DOYLESTOWN, PA 18901

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19 RIDGE ROAD
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CONSERVATION CHAIRMAN
PENNSYLVANIA FEDERATION OF
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SWAMP ROAD
NEWTON, PA 18940

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ZPG 211
REYNARD ROAD
R.D. 2
MALVERN, PA 19355

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315 EDWARDS ST.
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LEAGUE OF WOMEN VOTERS
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INTERLEAGUE COUNCIL OF THE
DELAWARE RIVER BASIN
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HOMEBUILDERS ASSN.
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DREXEL HILL, PA. 19026

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34 PALMERS MILL ROAD
MEDIA, PA 19063

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MRS. JEANETTE S. ROSE, CHAIRMAN
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WAWA, PA. 19063

WEST BRANCH YMCA
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CHESTER, PA. 19013

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19 TH. AND THE PARKWAY
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PHILADELPHIA, PA 19107

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RADNOR, PA 19087

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WAWA FARMS ASSOCIATION
250 NEW DARLINGTON RD.
WAWA, PA. 19063

CONSERVATION COUNCIL OF EASTERN PA
709 CLARENDON ROAD
PENN VALLEY, PA. 19072

AMERICAN YOUTH HOSTELS
4714 OLD YORK ROAD
PHILADELPHIA, PA 19141

DELAWARE VALLEY CONSERVATION
ASSOCIATION
1520 NORTH 15TH STREET
PHILADELPHIA, PA 19121

GERMANTOWN ECOLOGY ACTION GROUP
738 EAST PHIL-ELLENA STREET
PHILADELPHIA, PA 19119

CON. & ENV. PHILADELPHIA COUNTY

GARDEN CLUB OF AMERICA
ZONE 5 CONSERVATION CHAIRMAN
THE PLANTERS
915 SORREL LA.
BRYN MAWR, PA. 19010

JOHN J. MCGARRY, EXEC. SEC.
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PHILA., PA. 19103

PHILADELPHIA CONSERVATIONISTS, INC
1518 PACKARD BUILDING
PHILADELPHIA, PA 19102

PENNSYLVANIA ENVIRONMENTAL COUNCIL
313 SOUTH 16TH STREET
PHILA., PENNA. 19102

PENNSYLVANIA CONSERVATION VOTERS
3116 GAUL ST.
PHILADELPHIA, PA 19104

SCHUYLKILL VALLEY NATURE CENTER
HAGY'S MILL ROAD
PHILADELPHIA, PA 19128

SIERRA CLUB
C/O MR. MARTIN DAVENPORT
10TH FLOOR
1500 CHESTNUT ST.
PHILA., PA. 19110

INSTITUTE FOR ENVIRONMENTAL
PLANNING
3400 WALNUT STREET
PHILADELPHIA, PA 19104

NATURAL AND HISTORIC
RESOURCE ASSOCIATION
313 SOUTH 16TH STREET
PHILADELPHIA, PA 19102

PHILADELPHIA ECOLOGY ACTION GRC
3907 SPRUCE STREET
PHILADELPHIA, PA 19104

PENN-JERDEL OPEN SPACE
1717 SPRING GARDEN STREET
PHILADELPHIA, PA 19130

RIVER ASSOCIATES INC.
PIER 9 NORTH
PHILA., PA. 19106

SAVE THE DELAWARE COALITION
2015 LAND TITLE BUILDING
PHILADELPHIA, PA. 19110

WATER RESOURCES ASSOC OF THE
DELAWARE RIVER BASIN
21 SOUTH 12TH STREET
PHILADELPHIA, PA 19107

CON. & ENV. NATIONAL LEVEL

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8940 JONES MILL ROAD
WASHINGTON, DC 20015

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SUITE 300
WASHINGTON, DC, 20036

CLEAN WATER ACTION PROJECT
BOX 19312
WASHINGTON, DC, 20036

THE CONSERVATION FOUNDATION
1717 MASSACHUSETTS AVE., N.W.
SUITE 300
WASHINGTON, DC, 20036

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1717 MASSACHUSETTS AVE., N.W.
WASHINGTON, D.C. 20036

EXECUTIVE VICE PRESIDENT
DUCKS UNLIMITED
P.O. BOX 66300
CHICAGO, IL 60666

ENVIRONMENTAL POLICY CENTER
324 C STREET
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ATLANTIC STATES MARINE FISHERIES
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WASHINGTON, DC, 20036

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ENVIROMENTAL QUALITY
1700 PENNSYLVANIA AVE., N.W.
WASHINGTON, DC, 20006

CONCERN, INC.
2233 WISCONSIN AVE., N.W.
WASHINGTON, DC, 20007

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712 DUPONT CIRCLE BUILDING
1346 CONNECTICUT AVENUE, N.W.
WASHINGTON, D.C. 20036

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CONSERVATION FOUNDATION
1717 MASSACHUSETTS AVE., N.W.
WASHINGTON, D.C. 20036

DEFENDERS OF WILDLIFE
2000 N STREET, N.W., SUITE 201
WASHINGTON, DC, 20036
ATTN MR. TOBEY COOPER

EDWARD THOMPSON, JR.
ENVIRON. DEFENSE FUND
1525 18TH. ST. N.W.
WASH., D.C. 20036

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ENVIRONMENTAL POLICY CENTER
324 C ST., S.E.
WASHINGTON, D.C. 20003

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FRIENDS OF THE EARTH
620 C STREET, S.E.
WASHINGTON, D.C. 20003

MRS. MART W. REEVES, CONS. CHM.
GARDEN CLUB OF AMERICA
6307 DIAMOND HEAD
DALLAS, TEXAS 75225

INST FOR THE DEVELOPMENT OF
RIVERINE AND ESTUARINE SYSTEMS
ROOM 404, FIRL
20 AND RACE STREETS
PHILADELPHIA, PA 19103

LEAGUE OF WOMEN VOTERS OF
THE DISTRICT OF COLUMBIA
1346 CONNECTICUT AVE., N.W.
WASHINGTON, DC, 20036

NATIONAL PARKS AND CONSERVATION
ASSOCIATION
1701 18TH STREET, N.W.
WASHINGTON, DC, 20009

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NATIONAL WILDLIFE FEDERATION
1412-16TH ST., N.W.
WASHINGTON, D.C. 20036

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WASHINGTON, D.C. 20036

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CHESTER COUNTY, INC.
MERCY COLLEGE
DOBBS FERRY, N.Y. 10522

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DEPT. OF BOTANY
UNIVERSITY OF MASSACHUSETTS
AMHERST, MASS. 01002

INSTITUTE OF ECOLOGY
1717 MASSACHUSETTS AVE., N.W.
WASHINGTON, DC, 20036

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WASHINGTON, DC.

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WASHINGTON, D.C. 20036

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NATIONAL WILDLIFE FEDERATION
1412 - 16TH STREET, N.W.
WASHINGTON, D.C. 20036

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950 THIRD AVE.
NEW YORK, N.Y. 10022

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145 EAST 52ND ST.
NEW YORK, N.Y. 10022

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GENERAL FEDERATION OF
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1734 N. STREET, N.W.
WASHINGTON, DC 20036

POTOMAC RIVER BASIN ADVISORY
COMMITTEE
1025 VERMONT AVE., N.W.
WASHINGTON, DC, 20005

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POTOMAC VALLEY CONS. & REC. COUNCI
4201 MASSACHUSETTS AVE.
WASHINGTON, D.C. 20016

RACHEL CARSON TRUST FOR THE
LIVING ENVIROMENT, INC.
8940 JONES MILL ROAD
WASHINGTON, DC, 20015

RESOURCES FOR THE FUTURE, INC.
1755 MASSACHUSETTS AVE., N.W.
WASHINGTON, DC, 20036

EXECUTIVE DIRECTOR
SHELLFISH INSTITUTE OF NO. AMERIC
SUITE 9
212 WASHINGTON AVE.
BALTIMORE, MD 21204

SIERRA CLUB, SOUTH JERSEY GROUP
282 WESTERN WAY
PRINCETON, NJ 08540

SIERRA CLUB
33 CORONA ROAD
EAST BRUNSWICK, NJ 08816

SIERRA CLUB
NRRC
152 EAST SAN MATEO RD.
SANTA FE, NEW MEXICO 87501
ATTN: HENRY H. ZELLER

DIRECTOR
SPORT FISHING INSTITUTE
608 THIRTEENTH ST., N.W.
SUITE 801
WASHINGTON, DC, 20005

CON. & ENV. NATIONAL LEVEL

SIERRA CLUB WASHINGTON OFFICE
324 C STREET, S.E.
WASHINGTON, D.C. 20003

DR. M. LEE WATSON
STAFF SCIENTIST
ENVIRONMENTAL DEFENSE FUND
162 OLD TOWN ROAD
EAST SETAUKET. N.Y. 11733

SIERRA CLUB
324 C STREET, S.E.
WASHINGTON, D.C. 20003

MR ANTHONY WAYNE SMITH
NATIONAL PARKS & CONSERVATION ASS
1701 - 18TH STREET, N.W.
WASHINGTON, D.C. 20009

URBAN ENVIRONMENTAL EDUCATION
6319 SEVENTH STREET, N.W.
WASHINGTON, DC, 20011

MR. AUTHUR T. WRIGHT
WILDERNESS SOCIETY
1901 PENNSYLVANIA AVE.
WASHINGTON, D.C. 20006

MR. DANIEL POOLE, PRES.
WILDLIFE MANAGEMENT INSTITUTE
709 WIRE BLDG.
WASHINGTON, D.C. 20005

MARINAS

DELAWARE RIVER OUTBOARD AND MARINA
RIVER ROAD R450
NEW CASTLE, DEL 19720

FORT CHRISTINA MARINA M810
1126 E. 7TH ST.
WILMINGTON, DEL 19801

RAMBLER BOAT WORKS, INC. R
401 A ST.
WILMINGTON, DEL 19801

ANGLER'S RESTAURANT
LEWES, DE. 19958

ASH'S MARINA
RD #2
LEWES, DE. 19958

CANAL BOAT YARD
LEWES, DE. 19958

MARINAS - SUSSEX CO.

DEWEY BEACH PUBLIC LAUNCHING RAMP
DEWEY BEACH
REHOBOTH BEACH, DE. 19971

ELLIS MARINE, INC.
121 FRONT ST.
LEWES, DE. 19958

HOLTS LANDING STATE PARK
P.O. BOX 76
MILLVILLE, DE. 19967

INDIAN RIVER BOAT BASIN INC.
BOX 813
REHOBOTH BEACH, DE. 19971

INDIAN RIVER WATER SPORTS CLUB
OAK ORCHARD
MILLSBORO, DE. 19966

KOHLER'S MARINE
RD 1
BOX 298
MILLSBORO, DE. 19966

LEWES PUBLIC LAUNCHING RAMP
FRONT ST.
LEWES, DE. 19958

LEWES HARBOR MOTEL & MARINA
LEWES, DE. 19958

DOLLY'S MARINA
LOVE CREEK BRIDGE
LEWES, DE. 19958

HENLOPEN ACRES YACHT
REHOBOTH BEACH, DE. 19971

HAINES LANDING
RD #1
BOX 203 B
MILLSBORO, DE. 19966
(APRIL-OCT.)

INDIAN RIVER MARINA
OAK ORCHARD
MILLSBORO, DE. 19966

INDIAN RIVER YACHT CLUB
OAK ORCHARD
MILLSBORO, DE. 19966

LEWES YACHT CLUB
WEST CEDAR AVE.
LEWES, DE. 19958

LEWES BOAT YARD
FRONT ST.
LEWES, DE. 19958

LOVE CREEK
LEWES, DE. 19958

MARINAS - SUSSEX CO.

MURRAY'S YACHT BASIN, INC.
WHITE'S CREEK
P.O. BOX 35
OCEAN VIEW, DE. 19970

PILOT TOWN YACHT BASIN
410 PILOT TOWN RD.
LEWES, DE. 19958

REHOBOTH BAY MARINA INC.
DEWEY BEACH
REHOBOTH BEACH, DE. 19971

SOUTH SHORE MARINA INC.
INDIAN RIVER INLET
BETHANY BEACH, DE. 19930

SHOCKLEY'S BOATEL
ROUTE 1
SELBYVILLE, DE. 19975

ALTON MARINA
307 N.PEMBROKE
MARGATE CITY,NJ 08402

CORLETO MARINE
800 BAY AVENUE
SOMERS POINT,NJ 08244

CAPT. ANDY'S
9317 AMHERST AVENUE
MARGATE CITY,NJ 08402

MASSEY'S LANDING
MILLSBORO, DE. 19966

PIER POINT MARINA
P.O. BOX 152
REHOBOTH BEACH, DE. 19971

REHOBOTH BAY SAILING ASS.
DEWEY BEACH
REHOBOTH BEACH, DE. 19971

SHORT'S SALES & SERVICE
OAK ORCHARD
MILLSBORO, DE. 19966

TIMMONS MARRINA
R.D. #1
BOX 40
DAGSBORO, DE. 19939

BASS HARBOR MARINA
BASS HARBOR
SOMERS PT,NJ 08244

CAMPBELL'S MARINIA
BOX 171
NORTHFIELD,NJ 08225

DICKS DOCK INC.
936 BAY AVENUE
SOMERS POINT,NJ 08244

MARINAS - ATLANTIC CO.

GRAEIS BOAT YARD
PO BOX 96
SOMERS POINT N.J. 08244

HACKNEYS BOAT YARD
RTE 563
MARGATE BRIDGE RD
NORTHFIELD,NJ 08225

HOLIHAUGHS GATEWAY MARINA
RT559 AT PATCONG CREEK
SOMERS POINT,NJ 08244

LANDING CREEK BOAT YARD
RD#1,MAYS LANDING ROAD
SCULLVILLE,NJ 08330

HAVEN MARINA
824 BAY AVENUE
SOMERS POINT,NJ 08244

MARGATE CITY YACHT CLUB
412 N.VENDOME AVENUE
MARGATE CITY,NJ 08402

NELSON YACHT CLUB
MAYS LANDING ROAD
SOMERS POINT,NJ 08244

PATCONG HARBOR MARINA
MAYS LANDING ROAD
SCULLVILLE,NJ 08330

HOLIDAY HARBOR
610 BAY AVENUE
SOMERS POINT,NJ 08244

HOLIDAY MARINA
900 N JEROME AVE
MARGATE,NJ 08402

LONGPORT MARINE CO.
26TH AND BAY
LONGPORT,NJ 08403

MARGATE MARNER MOTEL AND BOATEL
9511 AMHERST AVENUE
MARGATE,NJ 08402

MAINLAND MARINA
BOX 127
NORTHFIELD,NJ 08225

MEADOWVIEW MARINA
BOX 185 THOMPSON LANE
MAYS LANDING,NJ 08330

PEKE-A-BOO MARINA
MARGATE TOLL BRIDGE
MARGATE,NJ 08402

RAYS BOATS
120 HIGBEE AVENUE
SOMERS POINT,NJ 08244

MARINAS - ATLANTIC CO.

RAINBOW TRAIL BOATING CENTRE
MAYS LANDING ROAD
SCULLVILLE,NJ 08330

SOMERSPOINT YACHT BASIN
520 BAY AVENUE
SOMERS PT. NJ 08244

SCOTTS DOCK
9211 AMHERST AVENUE
MARGATE CITY,NJ 08402

TIDEWATER MARINA CO.INC
BAY AVE
SOMERS POINT,NJ 08244

WACKI WHALE MARINA
9401 AMHERST AVENUE
MARGATE CITY,NJ 08402

ART'S RANCOCAS MARINA R675
FOOT OF LAYCOCK ST.
RIVERSIDE TWP., NJ 08075

BRIDGEBORO MARINA R840
967 BRIDGEBORO RD.
BRIDGEBORO
DELRAN TWP., NJ 08075

CURTIN MARINA R886
E. PEARL ST.
BURLINGTON, NJ 08016

RIVER BEND MARINA
MAYS LANDING RD AND ENGLISH CRE
MAYS LANDING,NJ 08330

SMITHS PIER
910 BAY AVENUE
SOMERS POINT,NJ 08244

SPOONYS MARINA
RIVER DR AT GREAT EGG HARBOR RI
MAYS LANDING,NJ 08330

WIN BRADYS DOLPHIN DOCK INC
924 BAY AVENUE
SOMERS POINT,NJ 08244

WHARF ROAD MARINA
RT 1 BOX 276
MAYS LANDING,NJ 08330

BIG "O" VALLEY MARINA R
RT. 130
RANCOCAS CREEK
WILLINGBORO, NJ 08046

CASTLE HARBOR MARINA 210
81. MIHIEL DR.
RIVERSIDE TWP., NJ 08075

DAN'S BOAT YARD R895
130 RANCOCAS AVE.
DELANCO TWP., NJ 08075

MARINAS - BURLINGTON CO.

DREDGE HARBOR YACHT BASIN 240
ST. MIHIEL DR.
RIVERSIDE TWP., NJ 08075

JERSEY MARINE EQUIPMENT CO. R&70
ST. MIHIEL DR.
RIVERSIDE TWP., NJ 08075

RIVERSIDE MARINA 200
NORMAN AVE.
DREDGE HARBOR
RIVERSIDE TWP., NJ 08075

PROFESSIONAL BOAT SERVICES, INC.
BROADWAY AND BIG TIMBER CREEK 50
BROOKLAWN, NJ 08030

U.S. COAST GUARD STATION
KING ST.
GLOUCESTER CITY, NJ 08030

THE ANCHORAGE
88TH STREET
SEA ILSE CITY,NJ 08243

BOYERS MARINA
242 BAY AVENUE
OCEAN CITY,NJ 08226

CAPE ISLAND MARINA, EAST 300
OCEAN DRIVE
CAPE MAY, NJ 08204

EHLE'S MARINA R&65
CREEK RD.
DELANCO TWP., NJ 08075

P. EVANSON BOAT CO., INC. 70
RESERVE AVE.
DREDGE HARBOR
RIVERSIDE TWP., NJ 08075

JOE'S MARINA R&25
1210 CREEK RD.
BELLMAWR, NJ 08030

TIDEWATER SHIP AND YACHT YARD R&15
2735 BUREN AVE.
CAMDEN, NJ 08105

ALL SEASONS MARINA
34TH STREET AT THE BAY
MARMORA,NJ 08223

BREE-ZEE-LEE YACHT BASIN R&150
LOWER TOWNSHIP OCEAN DRIVE
CAPE MAY, NJ 08204

BAY VIEW MARINA
312 BAY AVENUE
OCEAN CITY,NJ 08226

CAPE ISLAND MARINA, WEST 159
ROUTE 9 AT INLAND WATERWAY
CAPE MAY, NJ 08204

MARINAS - CAPE MAY CO.

CEDAR CREEK BOAT WORKS 0
51 YACHT AVENUE
CAPE MAY, NJ 08204

DEVERS MARINE BASIN
42ND STREET AND CANAL
SEA ISLE CITY,NJ 08243

DRY DOCK MARINA
7TH STREET AND THE BAY
OCEAN CITY,NJ 08226

FRANKS TEXACO
INNER HARBOR
CAPE MAY, NJ 08204

HARBOR HOUSE MOTEL
2ND STREET AND BAY AVENUE
OCEAN CITY,NJ 08226

JAKES BOATS
44TH STREET AND BRIDGE
SEA ISLE CITY,NJ 08243

LARRYS DOCK
PUTNAM ROAD AND BAY
STRATHMERE,NJ 08248

MCDUELL MARINE SERVICE R&75
OCEAN DRIVE
CAPE MAY, NJ 08204

CLAYTONS BOAT YARD
34TH STREET AT THE BRIDGE
MARMORA,NJ 08223

DALTONS DOCK
40-60 BAY AVENUE
OCEAN CITY,NJ 08226

EDWARD H DEVERS AND SONS
44TH STREET AND VENICEAN ROAD
SEA ILSE CITY,NJ 08243

FRANKS BOATS
WHITTIER ROAD AT THE BAY
STRATHMERE,NJ 08248

HALLAMARINE ENTERPRIZES INC
112B BAYFRONT
OCEAN CITY,NJ 08226

LAWRENCE HAVEN, INC R&40
OCEAN DRIVE
CAPE MAY, NJ 08204

LEMONTS
308 BAY AVENUE
OCEAN CITY,NJ 08226

MAINLINE HARBOR
PO BOX 131
SEA ILSE CITY,NJ 08243

MARINAS - CAPE MAY CO.

PHARO BOATYARD AND YACHT BASIN 232
CAPE ISLAND CREEK
NORTH OF CANAL BRIDGE
CAPE MAY, NJ 08204

ROSEMAN'S BOAT YARD 21
SCHELLENGER'S LANDING
CAPE MAY, NJ 08204

THE LOBSTER HOUSE
FISHERMAN'S WHARF
CAPE MAY, NJ 08204

VAN'S MARINE R&130
LOWER TOWNSHIP OCEAN DRIVE
CAPE MAY, NEW JERSEY 08204

BAILEY'S MARINA 34
RIVER ROAD
MATTS LANDING, NJ 08327

COHANSEY RIVER MARINA, INC. 35
P.O. BOX 95
PIER ROAD
GREENWICH, NJ 08323

COLONIAL CRUISERS INC.
P.O. BOX 309
RIVER ROAD
MILLVILLE, NJ 08332

RALPH MCNEIL AND SON 10
MARINE DOCKING SERVICE
OCEAN DRIVE
CAPE MAY, NJ 08204

SPORTCRAFT FISHING FLEET
55 YACHT AVENUE
CAPE MAY, NJ 08204

TONY'S MARINE RAILWAY
CAPE MAY, NJ 08204

YORKS'
WASHINGTON ST.
CAPE MAY, NJ 08204

BIVALVE MARINE INC. 50
BIVALVE, NJ 08301

CAPT. DOWN'S BOAT HOUSE
FORTESCUE CREEK
FORTESCUE, NJ 08321

FAIRTON MARINA R
MAIN STREET
FAIRTON, NJ 08320
FAIRFIELD TWP.

MARINAS CUMBERLAND COUNTY

FLANIGAN BROS. BOATYARD 15
MAIN ST.
FAIRTON, NJ 08320
FAIRFIELD TWP.

GANDY'S BEACH R&100
GANDY'S BEACH
NEWPORT, NJ 08345

HUSTED'S LANDING R&100
R.D. NO. 4
BACK CREEK
ROCKVILLE RD.
BRIDGETON, NJ 08302

JOE'S MARINA R&60
RIVER ROAD
MATTS LANDING, NJ 08327

MOORE'S BOAT YARD
CEDARVILLE, NJ 08311

MAURICE RIVER MARINA 20
RIVER ROAD
LEESBURG, NJ 08327

NEWPORT LANDING MARINA R&50
LANDING RD
P.O. BOX 334
NEWPORT, NJ 08345

FINLEY'S BOAT BASIN
FORTESCUE, NJ 08321

HANCOCK'S HARBOR INC. R&125
R.D. NO. 2
BRIDGETON, NJ 08302

HAYES' DRIFTWOOD R&35
MAURICE RIVER ROAD
MATTS LANDING, NJ 08327

MONEY ISLAND MARINA 70
MONEY ISLAND
NEWPORT, NJ 08345
DOWNE TWP.

MILLER ROWBOATS R&33
FORTESCUE, NJ 08321

MAURICETOWN SHIPYARD INC
S. FRONT ST.
MAURICETOWN, NJ 08329

ROBINSON'S PENNY HILL MARINA R&2(
DORCHESTER, NJ 08316

MARINAS - GLOUCESTER CO.

SPRING GARDEN BOAT WORKS 15
SPRING GARDEN RD
PORT ELIZABETH, NJ 08348

GLENVIEW MARINA 40
900 EDGEWATER AVE.
WESTVILLE, NJ 08093

OLDMAN'S CREEK MARINA R&10
R.D. NO. 2
SWEDESBORO, NJ 08085

KRUPA'S BOAT YARD
1035 LAMBERTON ST.
TRENTON, NJ 08611

MARLBORO MARINA R&S
1199 S. BROADWAY
SALEM PENNSVILLE RD
SALEM, NJ 08079

SALEM BOAT EXCHANGE
SALEM PENNSVILLE ROAD
SALEM, NJ 08079

FRANK MALONE MARINA, INC. 108
127 NESHAMINY RD.
CROYDON
BRISTOL TWP., PA 19020

BRIDGEPORT BOAT YARD R&25
ROUTE 322
BRIDGEPORT, NJ 08014

MULLEN'S DOCK R&2
ISLAND RD.
BRIDGEPORT, NJ 08014

DELAWARE MARINA R&100
2400 LAMBERTON RD.
TRENTON, NJ 08611

ROSS MARINE SERVICE R&17
2445 LAMBERTON RD.
TRENTON, NJ 08611

RIVERVIEW MARINA, INC. 30
FOOT OF FENNY RD.
PENNSVILLE, NJ 08070

ED'S BOAT YARD R&20
900 TOTEM RD.
CORNWELLS HEIGHTS
BENSALEM TWP., PA 19020

JACK'S BOAT RENTAL R
1057 TOTEM RD.
CORNWELLS HEIGHTS
BENSALEM TWP., PA 19020

MARINAS BUCKS COUNTY

MCDEVITT BOAT YARD R&10
531 TOTEM RD.
CORNWELLS HEIGHTS
BENSALEM TWP., PA 19020

SNUG HARBOR MARINA R&200
FOOT OF MAIN ST.
CROYDON
BRISTOL TWP., PA 19020

ANCHORAGE MARINA
FRONT AND JANSEN STS.
ESSINGTON, PA 19029

DARBY BOAT CO.
JEFFREY ST.
DELAWARE RIVER
CHESTER, PA 19013

FOX GROVE MARINA 40
400 FRONT ST
ESSINGTON, PA 19029

PHILADELPHIA SEAPLANE BASE R&26
MARINE DIVISION
WANAMAKER AVE. AND 2ND ST.
ESSINGTON, PA 19029

TINICUM YACHT YARD 30
FRONT AND SAUDE AVENUE
ESSINGTON, PA 19029

NESHAMINY MARINA R&150
NESHAMINY STATE PARK
CROYDON
BRISTOL TWP., PA 19020

SEYFERT AND WRIGHT BOAT YARD 50
900 6TH AVE.
CROYDON
BRISTOL TWP., PA 19020

DRIFTWOOD MARINA R&60
812 DARBY CRESCENT RD.
PROSPECT PARK, PA 19076

EDDYSTONE MARINA R&S
EAST 4TH ST.
RIDLEY CREEK
EDDYSTONE, PA 19013

GOV. PRINTZ MARINA 40
ESSINGTON, PA 19029

ROSSE BOAT REPAIR AND STORAGE YAR
FRONT AND LAGRANGE AVENUE 70
ESSINGTON, PA 19029

WILLOWBROOK MARINA AND SWIM CLUB
S. SWARTHMORE AVE. & DARBY R&100
P.O. BOX 131
RIDLEY PARK, PA 19078

PUBLIC UTILITIES AND RAILROADS

DELAWARE POWER AND LIGHT CO.
600 MARKET ST.
WILMINGTON, DE 19801

YARD MASTER
BALTIMORE AND OHIO RAILROAD
WILSMERE YARD
WILMINGTON, DE 19805

BALTIMORE AND OHIO RAILROAD
WILMINGTON, DE 19801

DIAMOND STATE TELEPHONE CO.
3900 WASHINGTON AVE.
WILMINGTON, DE 19808

SECRETARY COMPTROLLER
ARTESIAN WATER CO.
191 CHURCHMAN'S RD.
NEWARK, DE. 19711

PUBLIC SERVICE ELECTRIC & GAS CO.
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WVCH-AM RADIO
WOLF BUILDING
CHESTER, PA 19013

NEWS DIRECTOR
WXUR-AM/FM RADIO
1 SOUTH AVENUE
MEDIA, PA 19063

NEWS DIRECTOR
WDVR-FM RADIO
10 PRESIDENTIAL BOULEVARD
BALA CYNWYD, PA 19004

NEWS DIRECTOR
WIBG-AM RADIO
117 RIDGE PIKE
LAFAYETTE HILL, PA 19444

NEWS DIRECTOR
WIFI-FM RADIO
ONE DECKER SQUARE
BALA CYNWYD, PA 19004

NEWS DIRECTOR
WIOQ-FM RADIO
TWO DECKER SQUARE
BALA CYNWYD, PA 19004

NEWS DIRECTOR
WIBF-FM RADIO
TOWNSHIP LINE AND YORK ROADS
JENKINTOWN, PA 19046

NEWS DIRECTOR
WNAR-AM RADIO
OLD ARCH ROAD
NORRISTOWN, PA 19401

NEWS DIRECTOR
WNPV-AM RADIO
SNYDER ROAD, BOX 1440
LANSDALE, PA. 19446

NEWS DIRECTOR
WTAF-TV
330 MARKET STREET
PHILA., PA. 19106

NEWS DIRECTOR
WWSH-FM RADIO
555 CITY LINE AVENUE
BALA CYNWYD, PA 19004

NEWS DIRECTOR
WCAU-TV
CITY LINE AND MONUMENT AVES.
PHILADELPHIA, PA 19131

BROADCASTING STA. - PHILA. CO.

NEWS DIRECTOR
WCAU RADIO
CITY LINE & MONUMENT AVES.
PHILADELPHIA, PA. 19131

NEWS DIRECTOR
[illegible] RADIO
[illegible] RIDGE AVE.
PHILADELPHIA, PA. 19128

NEWS DIRECTOR
[illegible] RADIO
[illegible] CONSHOHOCKEN AVENUE
PHILADELPHIA, PA 19131

NEWS DIRECTOR
[illegible]-TV
3201 SOUTH 26TH STREET
PHILADELPHIA, PA 19145

NEWS DIRECTOR
WPVI-TV
4100 CITY LINE AVE.
PHILADELPHIA, PA 19131

NEWS DIRECTOR
WPEN-AM/FM RADIO
2212 WALNUT STREET
PHILADELPHIA, PA 19103

NEWS DIRECTOR
[illegible]-FM RADIO
1555 PINE STREET
PHILADELPHIA, PA 19102

NEWS DIRECTOR
WDAS-AM/FM RADIO
BELMONT AVE. & EDGELY RD.
PHILADELPHIA, PA 19131

NEWS DIRECTOR
WFIL-AM RADIO
4100 CITY LINE AVE.
PHILADELPHIA, PA. 19131

NEWS DIRECTOR
WIP-AM RADIO
19TH AND WALNUT STREETS
PHILADELPHIA, PA 19103

NEWS DIRECTOR
WMMR-FM RADIO
19TH AND WALNUT STREETS
PHILADELPHIA, PA 19103

NEWS DIRECTOR
WPHL-TV
1529 WALNUT STREET
PHILADELPHIA, PA 19102

NEWS DIRECTOR
WRBS-FM RADIO
440 DOMINO LANE
PHILADELPHIA, PA 19128

NEWS DIRECTOR
WRCP-AM/FM RADIO
2043 LOCUST STREET
PHILADELPHIA, PA 19103

BROADCASTING STA. - PHILA. CO.

NEWS DIRECTOR
WTEL-AM RADIO
4140 OLD YORK ROAD
PHILADELPHIA, PA 19140

NEWS DIRECTOR
WWDB-FM RADIO
3930 CONSHOHOCKEN AVENUE
PHILADELPHIA, PA 19131

NEWS DIRECTOR
KYW-AM RADIO
5TH AND MARKET STS.
PHILA., PA. 19106

NEWS DIRECTOR
WUHY-FM RADIO
4548 MARKET STREET
PHILADELPHIA, PA 19139

NEWS DIRECTOR
KYW-TV
5TH AND MARKET STS.
PHILA., PA. 19106

NEWS DIRECTOR
WYSP-FM RADIO
1617 JOHN F. KENNEDY BOULEVARD
PHILADELPHIA, PA 19124

TOTAL INTERESTED PARTIES 1893 END OF JOB

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-R

23 February 1978

Dear Sir:

I am pleased to inform you that we have initiated the Delaware River Dredging Disposal Study. The purpose of this Congressionally authorized study is to develop a regional dredging spoil disposal plan for the tidal portions of the Delaware River, its tidal tributaries, and Delaware Bay, extending from Trenton, New Jersey, to the sea. This study was authorized by the United States Senate Committee on Public Works on 20 September 1974. Efforts in the following year will concentrate on establishing a systematic program for conducting the study.

The study is expected to include investigations of the following: current and future dredging requirements of Federal, State and private interests; potential future spoil disposal sites; alternative dredged spoil disposal and utilization techniques; competing land use demands among agricultural, industrial, environmental and navigational interests; and economic, environmental and social impacts of all potential alternatives. The study will also assess the current and projected future problems associated with present dredging disposal methods and include an active public involvement and participation program.

We welcome any contribution you can make to this study. In particular, your views regarding the significance of the dredging disposal problem would be appreciated.

We look forward to your assistance. As the study progresses, we will inform you of major developments, so that your views may be obtained on all aspects.

Sincerely yours,

JOEL T. CALLAHAN
Lieutenant Colonel, Corps of Engineers
Acting District Engineer

AGENCY CORRESPONDENCE

philadelphia

CITY OF PHILADELPHIA

CARMEN F. GUARINO
COMMISSIONER

WATER DEPARTMENT
1180 MUNICIPAL SERVICES BUILDING
PHILADELPHIA, PA. 19107

February 28, 1978

Joel T. Callahan
Lieut. Colonel, Corps of Engineers
Acting District Engineer
Department of the Army
Custom House, 2nd and Chestnut Sts.
Philadelphia, Pa. 19106

RE: Your NAPEN-R

Dear Colonel Callahan:

Thank you for your letter of February 23, 1978 in which you informed me that the Corps of Engineers has initiated the Delaware River Dredging Disposal Study. The items contained in your proposed investigation seem to cover what would be necessary to attain knowledge in order to assess any current and projected future problems associated with present dredging disposal methods.

Our primary interest in your study stems that the City of Philadelphia operates the Torresdale Water Treatment Plant on the Delaware which provides drinking water to over one million persons as well as the needs of industry. In the operation of the Torresdale Plant, we are concerned that dredging on the Delaware and disposal of dredge spoil will not impact the water supply to the Torresdale Water Treatment Plant. In the past, poor dredging methods and inadequate supervision of dredging contracts had unnecessarily raised the turbidity levels of the river water causing the Water Department to experience considerable additional expenditures for chemicals used in the treatment of these turbid waters. We would like to point out that improper dredging and disposal methods can resuspend elements undesirable for water supplies into the water column. These elements heretofore have been part of the bottom deposits of the river.

As your study progresses, we will appreciate if you would inform us of any major developments. I would also like to assure you that you would have our assistance in the event you found this necessary and desirable.

Yours truly,

Carmen F. Guarino

Carmen F. Guarino
Water Commissioner

CITY OF CAMDEN
DIVISION OF ECONOMIC DEVELOPMENT
CITY HALL -- 10th FLOOR
CAMDEN, NEW JERSEY 08101

(609) 757-7488

JOHN R. OBER
DIRECTOR

March 6, 1978

Mr. Joel T. Callahan
Lieutenant Colonel, Corps of Engineers
Acting District Engineer
Department of the Army
Philadelphia District Corps of Engineers
Custom House - 2D & Chestnut Streets
Philadelphia, Pennsylvania 19106

Dear Colonel Callahan:

In response to your letter to the City of Camden of February 23rd I should like to advise you that the City owns land that might be suitable for a spoils disposal area.

As to future dredging requirements the City is about to begin an extensive port expansion program that no doubt will require additional dredging.

I would like to meet with you to explain our problem so that they will be considered by the Corps in future plans.

Please contact my office at your earliest convenience to arrange a meeting.

I look forward to co-operating with you on this very important project.

Very truly yours,

JOHN R. Ober
Director

JRO/dc

SHIP VIA PORT OF CAMDEN

STATE OF DELAWARE
DEPARTMENT OF NATURAL RESOURCES
& ENVIRONMENTAL CONTROL
DIVISION OF FISH AND WILDLIFE
EDWARD TATNALL BUILDING
DOVER, DELAWARE 19901

OFFICE OF THE DIRECTOR

PHONE (302) 678 4431

March 7, 1978

Mr. Joel T. Callahan
Lieutenant Colonel, Corps of Engineers
Acting District Engineer
Department of the Army
Custom House 2nd & Chestnut Sts.
Philadelphia, Pa. 19106

Dear Lt. Col. Callahan:

The Delaware Division of Fish and Wildlife, Department of Natural Resources and Environmental Control, is pleased to acknowledge your Delaware River Dredging Disposal Study. We will assist you in all phases regarding our fish and wildlife resources to our mutual concern for the conservation of their habitat.

Respectfully

Charles A. Lesser
Manager of Fisheries

CAL:ef

STATE OF NEW JERSEY
DEPARTMENT OF PUBLIC UTILITIES

GEORGE H. BARBOUR
COMMISSIONER
NEWARK, N.J.

March 7, 1978

Joel T. Callahan
Lieutenant Colonel, Corps of Engineers
Department of the Army
Custom House - 2D & Chestnut Streets
Philadelphia, PA

Dear Colonel Callahan:

Thank you for your letter of February 23, 1978 regarding the Delaware River Disposal Dredging Study.

As President of the Board of Public Utilities, I can advise you that this agency has no relationship to the proposed dredging study.

Sincerely,

George H. Barbour
President

COUNTY OF BUCKS

BUCKS COUNTY PLANNING COMMISSION

Cross Keys Office Center, Box12 · 4259 Swamp Road, Doylestown, Pa. 18901 – 215–348-2911

March 7, 1978

Joel T. Callahan, Lt. Colonel
Acting District Engineer, Corps of Engineers
Department of the Army, Custom House
2nd and Chestnut Streets
Philadelphia, Pa. 19106

Dear Col. Callahan:

We were interested to learn of the Delaware River Dredging Disposal Study which your office has initiated. You may be aware that the Bucks County Planning Commission has been very interested in the problems of soil erosion and we have worked with local government to enact regulations which would retain soil on the land and limit soil erosion caused by water runoff. Other Bucks County agencies such as the Bucks County Conservation District have been working with farmers and other large land owners to limit soil erosion.

We are most interested in two aspects of your study:
1) What areas will be dredged?
2) Where are the disposal sites?
When your study reaches a point where recommendations are offered for these two questions, we would like to have the opportunity to comment.

Sincerely yours,

Kenneth D. Kugel, Chief
Countywide Planning

KDK/KBL/ko

STATE OF DELAWARE
DEPARTMENT OF COMMUNITY AFFAIRS
& ECONOMIC DEVELOPMENT
DIVISION OF ECONOMIC DEVELOPMENT
630 STATE COLLEGE ROAD
DOVER, DELAWARE 19901
PHONE (302) 678-4254

March 9, 1978

Lt. Colonel Joel T. Callahan
Acting District Engineer
Corps of Engineers
Custom House - 2nd & Chestnut Streets
Philadelphia, Pennsylvania 19106

Dear Colonel Callahan:

We recently received your notification of the pending study to be conducted for the purpose of establishing a regional dredging spoil plan for the tidal portions of the Delaware River. The Division of Economic Development, along with other state agencies, is very interested in participating and keeping abreast of the progress of this study.

Currently, the Division is attempting to encourage the development of Breakwater Harbor, in Lewes, as a support base facility for OCS activity. In addition, the Port of Wilmington is being encouraged to expand its operations, and several parcels of property along the Delaware River are being targeted for industrial activity. All of these particular projects will involve dredging to some degree. How extensive the dredging will be has yet to be determined but if any of the projects move off the drawing board, they should play a role in the disposal study.

As we become aware of details concerning these and any other projects, we will send them to you. If you have any questions, please contact me any time.

Cordially,

William J. McDermott
William J. McDermott
Industrial Development Coordinator

WJMc:jpw

COUNTY OF DELAWARE
COURT HOUSE
MEDIA, PENNSYLVANIA 19063

A C 215-891-2381

FAITH RYAN WHITTLESEY
CHAIRMAN
CHARLES C. KEELER
VICE CHAIRMAN
WILLIAM A. SPINGLER

OFFICE OF THE PLANNING DEPARTMENT
WILLIAM H. BATES
CHAIRMAN
THOMAS J. JUDGE
VICE CHAIRMAN
HAROLD F. JONES
SECRETARY

9 March 1978

Lt. Colonel Joel T. Callahan,
Acting District Engineer
U.S. Army Corps of Engineers
Custom House
2nd & Chestnut Streets
Philadelphia, Pennsylvania 19106

RE: NAPEN-R. Delaware River
Dredging Disposal Study

Dear Colonel Callahan:

The Delaware County Planning Department will be happy to participate in the Delaware River Dredging Disposal Study.

Most of our recent publications (Land Use 2000, Business Patterns, Industrial Patterns, Housing Plan) have been submitted to the Corps in relation to the Chester Creek Basin Study.

We would be happy to meet to supply data which we might have to assist you in the study.

Very truly yours,

H. Edward Miles

H. Edward Miles,
Associate Director

HEM/dc

Office of the
Department of Planning

Joseph T. Patermo, *PP, AIP*
Planning Director
Ralph L. Crollick, *PP, AIP (Assoc.)*
Deputy Director

Hilliard T. Moore, Sr.,
Freeholder Chairman,
Committee on Transportation & Planning

Camden County
2276 N. 43rd Street, Pennsauken, N.J. 08110
(609) 757-8620

March 9, 1978

Joel T. Callahan, Lieutenant Colonel
Corp of Engineers
Custom House, Second and Chestnut Streets
Philadelphia, Pennsylvania 19106

Re: Napen-R
Dredging Spoil Disposal Plan

Dear Lt. Col. Callahan:

As you are aware, Camden County in conjunction with DVRPC and the Army Corp is engaged in the 208 and SNJWRS studies and the findings from these studies will be relevant to the Dredging Disposal Study. Camden County looks forward to working closely with you on this project.

Camden County is also involved in two other programs which are relevant; the ongoing OCS Study and the Delaware River Water-front Communities District Planning Project could provide and specifically, the District Planning Project could serve as an element of the Corp Public Participation mechanism.

Very truly yours,

JOSEPH T. PATERMO, PP, AIP
Planning Director

JTP/cr
cc: Earl Bennett, Principal Planner

BUCKS COUNTY CONSERVATION DISTRICT
57 WEST COURT STREET
DOYLESTOWN, PENNSYLVANIA 18901

March 10, 1978

Lt. Colonel Joel T. Callahan
Acting District Engineer
U.S. Army Corps of Engineers
Custom House
2nd and Chestnut Streets
Philadelphia, Pa. 19106

Reference: NAPEN - R

Dear Lt. Colonel Callahan:

The Bucks County Conservation District does not have any direct involvement or high priority concerns in reference to the dredging disposal problem.

We are, however, vitally concerned with the preservation of agricultural land in Bucks County and the protection of our soil and water resources. In the event that dredge spoil disposal is proposed in Bucks County, this office would appreciate being notified.

Thank you for informing us about the Corps' study.

Respectfully yours,

David W. Acton

David W. Acton
Executive Assistant

COMMONWEALTH OF PENNSYLVANIA

DEPARTMENT OF ENVIRONMENTAL RESOURCES

P. O. BOX 1467

HARRISBURG, PENNSYLVANIA 17120

In reply refer to
RM
6-A.1

The Secretary

March 10, 1978

Col. Harry V. Dutchyshyn
District Engineer
Philadelphia District - Corps of Engineers
Custom House - Second and Chestnut Streets
Philadelphia, Pennsylvania 19106

Dear Colonel Dutchyshyn:

Governor Milton J. Shapp has asked me to reply to the letter of February 23, 1978, from Lieutenant Colonel Joel T. Callahan, Acting District Engineer, regarding the Congressionally authorized study to develop a regional dredging spoil disposal plan for the tidal portions of the Delaware River from Trenton, New Jersey, to the sea. I received a similar letter.

One thing we have become very much aware of, as we fulfilled our commitment to provide spoil disposal areas in Pennsylvania for the maintenance dredging of the Delaware River Ship Channel, was the unavailability of new spoil disposal areas as the old ones became filled to capacity. Once the remaining riverside disposal areas are filled, which could occur in less than ten (10) years, we foresee many problems and great expense in providing sites on which to place future dredged material.

Consequently, we are very pleased to learn that you have initiated this study. As the study progresses, if we can be of assistance, we will be happy to cooperate in any way possible.

As you are aware, the Department of Environmental Resources is responsible for the Commonwealth's participation in the Delaware River Ship Channel maintenance dredging program. It would be appreciated if you would keep me advised of your progress in the study and thereby assure our full cooperation as it is needed.

Sincerely yours,

Maurice K. Goddard

MAURICE K. GODDARD

STATE OF DELAWARE
DIVISION OF HISTORICAL AND CULTURAL AFFAIRS
HALL OF RECORDS • DOVER • 19901
(302) 678-5314

March 13, 1978

Mr. Joel T. Callahan
Lieutenant Colonel, Corps of Engineers
Acting District Engineer
Department of the Army
Custom House
2nd & Chestnut Streets
Philadelphia, Pennsylvania 19106

Dear Lt. Col. Callahan:

The Division of Historical and Cultural Affairs is willing to assist the Army Corps of Engineers with whatever relevant information it may contribute to your regional dredging spoil disposal plan. The Bureau of Archaeology and Historic Preservation is the agency within this Division which maintains the cultural resource data from the state and will therefore be the responsive bureau for this matter.

At the outset, I would like to express our primary concerns surrounding any proposed dredging operations. First, there is a potential adverse effect on cultural resources as the result of the actual dredging as well as, through vegetation clearing, and equipment placement. Second, where is the spoil disposal sites to be located? This placement may adversely effect cultural resources as well.

Presently, our comprehensive survey of the cultural resources of Delaware is far from complete. However, the information we have available for actual and anticipated resource location may provide valuable planning assistance. May I suggest that you contact Ms. Faye L. Stocum, Bureau of Archaeology and Historic Preservation, at the above address for further coordination on this matter.

Sincerely,

Lawrence C. Henry
Director/State Historic
Preservation Officer

CAPE MAY COUNTY PLANNING BOARD

March 15, 1978

Joel T. Callahan, Lieutenant Colonel
Army Corps of Engineers
Custom House - 2nd & Chestnut Streets
Philadelphia, Pennsylvania 19106

Dear Colonel Callahan:

We are pleased to learn that a Delaware River Dredging Disposal Study has been initiated. While it is quite likely that the major focus of the Study will be on the major shipping channel, its related tributaries and facilities, we wonder if the following subjects and areas will receive attention.

1. A long range plan for utilization of dredge spoils of suitable quality for the restoration and maintenance of beaches on the lower Cape May County coast, including Middle Township, Lower Township, Cape May Point, and Cape May City.

2. The maintenance of general purpose access channel approaches to the Cape May Canal.

3. The opening and maintenance of small craft access channels to Bidwell's Creek.

Please advise me if the scope of the Study is flexible enough to consider the above subjects so that we may follow its progress and make suggestions on specific topics of concern.

Sincerely,

Elwood R. Jarmer
Director

ERJ:de
cc: Freeholder Thornton
Congressman Hughes
Mr. Neil Clarke, Co. Engineer
Mr. Fred Coldren, Federal Funding

cape may court house, new jersey 08210·609-465-7111

DELAWARE RIVER BASIN COMMISSION
P. O. BOX 7360
WEST TRENTON, NEW JERSEY 08628
(609) 883-9500

GERALD M HANSLER
EXECUTIVE DIRECTOR

HEADQUARTERS LOCATION
25 STATE POLICE DRIVE
WEST TRENTON, N J

March 15, 1978

Lt. Colonel Joel T. Callahan
Acting District Engineer
U.S. Army Corps of Engineers
Custom House - 2 D & Chestnut Streets
Philadelphia, Pennsylvania 19106

Re: NAPEN-R

Dear Colonel Callahan:

This is in response to your letter of February 23, 1978, informing the Delaware River Basin Commission that the Corps of Engineers has initiated a Delaware River Dredging Disposal Study, and soliciting the views of the Commission regarding the significance of the dredging disposal problem.

The Delaware River Basin Commission has long recognized the seriousness of the dredging disposal problem in the tidal Delaware River Basin and has supported and encouraged efforts for such a study. For your information, enclosed are copies of Commission Resolution No. 74-8, officially supporting such a study, and a letter of July 13, 1977 from Mr. Howlett to Colonel Dutchyshyn, reiterating the Commission's interest in this matter.

We are pleased to note it is intended that the study will include the requirements of the private sector, as well as those of the public sector. We would also suggest that the study investigate the possibility of incorporating Delaware Estuary waste treatment plant sludge for disposal along with the dredging spoils.

The Commission staff welcomes the opportunity to cooperate fully with the staff of the Corps of Engineers in all phases of this investigation.

Sincerely,

G. M. Hansler

Gerald M. Hansler

Enclosures

NO. 74-8

A RESOLUTION with regard to a dredging spoil disposal plan.

WHEREAS, the economic welfare of the Delaware Valley is dependent upon the maintenance of its deepwater navigation facilities; and

WHEREAS, to maintain navigation in the tidal Delaware River and its tributaries requires an average annual removal and disposal of nearly 11,000,000 cubic yards of material; and

WHEREAS, it is necessary to appraise the environmental consequences of utilizing either dry, marsh, or submerged lands at sites for disposal of dredging spoil: and

WHEREAS, the ever-increasing competition for land among agricultural, industrial, environmental and navigational concerns mandates an early resolution to these potential conflicts; and

WHEREAS, the U. S. Army Corps of Engineers has been authorized by Congressional resolution to study the feasibility of modifying the channel dimensions of the Delaware River and developing a regional port system for the Delaware Valley; and

WHEREAS, the U. S. Army Corps of Engineers and other agencies in the course of previous studies have amassed substantial data relating to the problems of spoil disposal which can form the basis of a sound regional site disposal plan; now therefore

BE IT RESOLVED by the Delaware River Basin Commission:

1. The U. S. Army Corps of Engineers, Philadelphia District, is requested to expedite its continuing authorized navigation studies and that its initial efforts be directed toward:

(a) The development of a dredging spoil disposal plan for the tidal Delaware River, its tidal tributaries and Delaware Bay; and

(b) Designation of specific sites which may be used, with minimum degradation of the natural environment, by both the public and private sectors for the disposal of dredging spoil during the next ten years and the identification of potential sites which may be used for this purpose thereafter.

2. During the course of preparing a dredging spoil disposal plan the U. S. Army Corps of Engineers is further requested to draw upon the services of and consult with other federal and state agencies having responsibilities for environmental protection of the Delaware Estuary and Bay.

3. Copies of this Resolution shall be made available to the Chief of Engineers, the Secretary of the Army and the Congressional delegates of the Delaware River Basin.

Chairman

Secretary

ADOPTED: June 26, 1974

DELAWARE RIVER BASIN COMMISSION
P. O. BOX 7360
WEST TRENTON, NEW JERSEY 08628
(609) 883-9500

~~JAMES F. WRIGHT~~
EXECUTIVE DIRECTOR

HEADQUARTERS LOCATION
25 STATE POLICE DRIVE
WEST TRENTON, N J

July 13, 1977

Col. Harry V. Dutchyshyn, Dist. Engr.
U. S. Army Corps of Engineers
Custom House
2nd and Chestnut Sts.
Philadelphia, Pa. 19107

Dear Col. Dutchyshyn:

As you know, the Delaware River Basin Commission is very much aware of the problem of finding suitable disposal sites for dredge spoil in the Delaware estuary region. The Commission has been involved in dredge spoil disposal problems upon various occasions in the past, most recently in connection with the American Dredging Company application (D-74-66 rev.). The preparation of an environmentally acceptable regional disposal plan for both the private and public sectors that identifies disposal sites is a vital need for this region at this time. Such a plan was officially supported by the Commission in June of 1974 in Resolution No. 74-8, copy of which is enclosed for your convenience.

It is our understanding that the Corps of Engineers has requested funds to initiate a Delaware River dredging disposal study during fiscal 1978, and that the prospects are very good that this study will be funded by the Congress. By this letter, I am reminding you of the Commission's interest in this matter and its desire to see a regional disposal plan brought into being at the earliest possible date. Commission staff will be glad to cooperate with your staff in the preparation of the study design and to make available whatever information it has that may be useful.

Sincerely,

Herbert A. Howlett
Chief Engineer and
Acting Executive Director

enc.
cc: Members of the DRBC

COMMONWEALTH OF PENNSYLVANIA

DEPARTMENT OF ENVIRONMENTAL RESOURCES

P. O. BOX 1467
HARRISBURG, PENNSYLVANIA 17120

March 16, 1978 Refer to RM-P-M

Lt. Col. Joel T. Callahan
Acting District Engineer
Philadelphia District, Corps of Engineers
Custom House - 2D & Chestnut Streets
Philadelphia, Pennsylvania 19106

Dear Colonel Callahan:

This letter is in response to your notice of February 23, 1978, regarding the initiation of the Delaware River Dredging Disposal Study.

The Bureau of State Parks operates the Neshaminy State Park Marina located on the Delaware River at Cornwells Heights, Pennsylvania. Under the terms of the Local Cooperation Agreement signed in April of 1964, the Corps of Engineers, pursuant to the requirements of Section 107 of the River and Harbor Act, is responsible for dredging the entrance channel, access channel, anchorage area and turning basin of the Marina.

We request that the above be considered during the course of your study. For your information, a disposal area for the dredging material still exists within Neshaminy State Park.

Please keep us informed as your study progresses.

Sincerely yours,

William C. Forrey

William C. Forrey, Director
Bureau of State Parks

COMMONWEALTH OF PENNSYLVANIA

DEPARTMENT OF ENVIRONMENTAL RESOURCES
POST OFFICE BOX 2063
HARRISBURG, PENNSYLVANIA 17120

March 16, 1978

In reply refer to:
14-11.3

Lieutenant Colonel Joel T. Callahan
Acting District Engineer
Department of the Army
Philadelphia District
Corps of Engineers
Custom House-2 D and Chestnut Streets
Philadelphia, PA 19106

Dear Colonel Callahan:

With reference to your letter of February 23, I enclose a copy of the study by Colonel Wisdom which included a consideration of the dredging disposal for the Delaware. I am sending this to you in case you have not seen a copy of this report.

With my best regards.

Sincerely yours,

Walter A. Lyon

Walter A. Lyon, Director
Bureau of Water Quality Management

Enclosure

DELAWARE VALLEY

REGIONAL PLANNING COMMISSION

Penn Towers Building, 1819 J. F. Kennedy Blvd., Philadelphia, Penna. 19103 LOcust 7-3000

March 21, 1978

Lieutenant Colonel Joel T. Callahan,
Acting District Engineer
Philadelphia District Corps of Engineers
Custom House, Second & Chestnut Sts.,
Philadelphia, Pennsylvania 19106

Dear Lt. Callahan:

Thank you for your letter announcing the initiation of the Delaware River Dredging Disposal Study.

The Delaware Valley Regional Planning Commission is actively involved in a number of planning projects which have a major interest in channel maintenance and spoil disposal.

We have prepared a Coastal Zone Management Program for the Pennsylvania side of the estuary, between Morrisville and Marcus Hook. A major area of interest in this program is the identification of areas appropriate for spoil disposal. The study emphasizes that disposal is a use of regional benefit and describes the process as being of "greater-than-local" concern. The study attempts to balance preservation of remaining natural areas, with a need to encourage port development and revitalize underutilized industrial riverfront. Critical areas for both preservation and shoreline development have been described and mapped in detail. Eventually funds will be channeled to local governments to enable them to review and revise comprehensive plans and zoning ordinances to reflect regional goals for the wise use of shorefront resources.

During the preparation of the Coastal Management Program we have contacted and worked closely with a number of Federal and State Agencies, county planning commissions, port authorities, riverfront industries and interested citizens. We have developed mailing lists and promoted the program through a special newsletter (copy attached).

In addition to being extremely familiar with Pennsylvania's Coastal Program we have maintained liaison with the coastal program in New Jersey and Delaware.

In addition to this work the DVRPC has recently completed a series of "208" Water Quality Management Plans for the nine county, 4000 square mile Delaware Valley Region. Part of the effort required research into

"Best Management Practices" (BMP) for controlling non-point source of pollution, including dredging.

In summary I am sure this office can be of assistance during the upcoming study. Depending on the level of our involvement you may wish to enter into a contract with this agency as was done for the Southern New Jersey Water Resources Study. If this is impossible we would be glad to assist in a study design or steering committee role. If you have any questions about our past efforts, or staff capabilities, please feel free to contact me.

Very truly yours,

Michael A Wolf

Michael A. Wolf, Chief
Land Resources Planning

ENCL:

DEPARTMENT OF THE ARMY
WATERWAYS EXPERIMENT STATION, CORPS OF ENGINEERS
P. O. BOX 631
VICKSBURG, MISSISSIPPI 39180

IN REPLY REFER TO WESYV

21 March 1978

SUBJECT: Delaware River Dredging Disposal Study

District Engineer
U.S. Army Engineer District, Philadelphia
Custom House--2D & Chestnut Streets
Philadelphia, PA 19106

1. We have been aware of, and have followed with interest, events leading to the authorization of the subject study, and feel that such a comprehensive regional plan is truly a major step toward a lasting solution to the dredged material disposal problems of the Delaware estuary.

2. You are no doubt aware of the general nature of the contribution that has been made as a result of our conduct of the Dredged Material Research Program (DMRP). Ending this month, the DMRP included many studies of a generic nature that should help establish a firm base from which to investigate the specific disposal effects and alternative disposal methods feasible in your area. In view of the nearly 200 reports to result from the DMRP (about 100 this fiscal year) and the recognized difficulty any field element will experience in knowing what is contained in this library of information and how it can be applied, an effort is being initiated at the Waterways Experiment Station that should be brought to your attention.

3. Under sponsorship of the Office, Chief of Engineers (Construction-Operations Division), we are establishing a technical advisory team for the specific purpose of assisting Corps Districts and Divisions and the agencies and groups they interrelate with in understanding the significance of DMRP results and how they can be applied to individual projects or studies. To be managed under the name Dredging Operations Technical Support (DOTS), this interpersonal mode of technology transfer will be available to your staff to assist you in implementing the Delaware River

21 MAR '78

WESYV
SUBJECT: Delaware River Dredging Disposal Study

Dredging Disposal Study or other activities in your District should you deem it necessary. Please contact me directly in the event we can be of assistance to you in this matter, and I indeed would like to be kept informed of the progress and major developments in your study.

John L. Cannon
JOHN L. CANNON
Colonel, Corps of Engineers
Commander and Director

DEPARTMENT OF THE AIR FORCE
REGIONAL CIVIL ENGINEER. EASTERN REGION (HQ USAF)
526 TITLE BUILDING. 30 PRYOR STREET. S.W.
ATLANTA. GEORGIA 30303

REPLY TO ATTN OF: ROV

27 March 1978

SUBJECT: Delaware River Dredging Disposal Study (Your Ltr, 23 Feb 78)

TO: Philadelphia District/NAPEN-R

1. The Air Force Regional Civil Engineer, Eastern Region, has been designated by Headquarters Air Force as the Air Force point of contact for subject study.

2. We will contact affected Air Force installations in the vicinities of the study area and request they evaluate and comment on their activities in relationship with the concern mentioned in your letter. Subsequent to that time, we will furnish your office with a consolidated Air Force response which may benefit you in developing the study.

3. Mr. Sherrill Shepherd will be the project manager for this study and may be contacted at FTS 242-6821.

FOR THE CHIEF OF STAFF

Robert L. Wong

ROBERT L. WONG
Chief, Environmental Planning Division

Cy to: HQ USAF/PREV

City of Wilmington, Delaware
City/County Building · 800 French Street 19801

WILLIAM T. McLAUGH
MAYOR

April 3, 1978

Department of the Army
District Corps of Engineers
Custom House
2nd & Chestnut Street
Philadelphia, PA 19106

ATTENTION: Joel T. Callahan, Lt. Col.
Corps of Engineers
Acting District Engineer

Gentlemen:

In response to your letter of February 23, 1978, New Castle County and the City of Wilmington wish to express their interest in participating in the dredge-spoil program proposed for the Delaware River maintenance.

As you may know, New Castle County presently operates a sanitary landfill on the site directly adjacent to the north side of the Delaware Memorial Bridges. The County owns property adjoining the landfill site to the north which abuts the existing Port of Wilmington property. This represents a control of the river front of approximately 7,000 lineal feet.

New Castle County and the Port of Wilmington have jointly discussed, with the Corps of Engineers, a program that would extend the existing lands to approximately the bulkhead line. It appears that approximately 250 acres of land could be created in this vicinity. This would extend from the Christina River south to approximately the railroad which is located at Pigeon Point. The bulkhead line would conform to the existing bulkhead line to the north of the Christina River which marks the limits of Cherry Island. Both the Pigeon Point landfill site and the areas to the north of the railroad were previously used by the Corps of Engineers for dredge-spoil areas.

Office of the Mayor (302) 571-4100

We appreciate the complex nature of dike construction out into the river. However, we also can visualize the extreme potential benefit to the citizens of Delaware and, in particular, the residents of New Castle County and the City of Wilmington for the development of this site through a partnership between the Corps of Engineers, the City of Wilmington, and New Castle County. Land could be created for dredge-spoil for the Corps for probably 10 to 15 years. Portions of this land could be utilized by the solid waste processing operations proposed for the County-owned property with the ultimate goal to expand the Port of Wilmington to take over these lands and thereby minimize the continuing dredging requirements of the Christina River to maintain the existing port operations.

The dredging disposal problem is one which has been affecting the Port of Wilmington's operations and will continue to become more of a problem in the future if solutions are not found and actions taken. The significance of the study lies in the fact that the Port's current spoil areas will approach maximum utilization by the year 1984. For this reason, a new spoil area to handle Christina River dredgings must be established and in operation prior to 1984. The establishment of this new spoil area will buy the time necessary for an expansion of the Port along the Delaware River where the dredging requirements will be substantially less. We would ask the Corps' maximum participation in the establishment of this spoil area.

A further possibility for the disposal of dredging spoil involves the use of a significant amount of spoil in the South Walnut Street area to raise the elevations above flood levels. Either the Corps would deposit the dredgings there or they could allow the City to remove consolidated spoil from disposal areas near the river which would save the cost of materials and increase the life of the spoil area.

A program of this type will definitely require large expenditures and is a plan that is far reaching with respect to time. We believe that all parties involved should meet to discuss this feasibility, and the sharing of cost and of benefits that may be derived from this plan. Whatever course is taken by the Corps it must be recognized that the Port of Wilmington and its continued operation is crucial to the vitality of the City, County, State and region. For this reason, we feel that the proposed study is of vital importance and we support it wholeheartedly.

We look forward to the opportunity to discuss this project with you. If there are any questions concerning the above, please do not hesitate to contact us.

Very truly yours,

W.T. McLaughlin
Mayor of Wilmington

Mary Jornlin
County Executive

IN REPLY PLEASE REFER TO

Phil. Dist. COE
Delaware River Dredging Study

State of New Jersey

DEPARTMENT OF TRANSPORTATION

ALAN SAGNER
COMMISSIONER

1035 PARKWAY AVENUE
TRENTON, NEW JERSEY 08625

April 18, 1978

Lt. Col. Joel T. Callahan
Acting District Engineer
Philadelphia District COE
Custom House, 2nd and Chestnut Sts.
Philadelphia, Pa.

Dear Sir:

As a first response to your solicitation of NJDOT views and/or informational input into the above-referenced study, please be advised that NJDOT is now in the process of collecting data that might be pertinent from our various Bureaus and Operational Units. Some facts and questions which come to mind relative to your study, as relates to NJDOT, without regard to continuity are:

(1). Projected major fill sites for NJDOT construction projects where the geographical location and volumes make it economically advantageous to use dredge spoil should be identified.

(2). Suitability of dredge spoil as load bearing embankment under roadways? Does the soil vary radically in different parts of the river? Can it be used for off-roadway fills?

(3). What is the cost-efficiency ratio in terms of the volume of material available, stockpiling and hauling, hydraulic filling against the utilization of nearby available upland borrow piets, in any one geographic area. Seems that all sites would have to be reasonably close to the river, unless vast stockpile areas are available.

(4). The SEE effects of utilization of dredged spoil for highway work are factors which would have to be cleared thru EIS statements to U.S.E.P.A. for any project. A clear identification of these effects would have to be determined.

(5). The time frames involved would be important as coordinated NJDOT-COE operations would be involved. Time frames might also be important as relates to the methods of transporting the material to the final site, stockpiling, hydraulic pumplines etc. in terms of possible adverse public acceptance. (Sloppy areas, odor, etc.)

(6). Whole areas of acceptable material for NJDOT fills would have to be documented so that NJDOT construction bidders know that enough material is available and suitable for embankment. The methods of construction as it relates to a NJDOT contract generates a whole line of questions, e.g.

a. The responsibility of the stockpiling. Maintaining security in stockpile areas. (Public) Maintaining sloughage.

b. Direct pumping to the site? By who? The Contractor? The Corps? Who is responsible for the structural integrity of the spoil? How about down time? (Usually 20% in hyraulic fill operation) How do we pay contractor for Corps down time.

c. How about indemnification and personal liability in Contractor-Corp operations?

d. Borings would have to be analyzed and approved by NJDOT Soils Bureau.

(7). In order to get FHWA to participate in the costs of using Corp material, certain documentations will have to be made, such as soil quality, availability and locations, quantities, etc. What costs to NJDOT are involved? Does the Corps consider the material waste or would they be expecting monetary credit?

(8). A lot of agreements (NJDOT-Corps FHWA) would have to be promulgated running the whole gamut caused by Contractural legalities and covered by the Specifications for construction responsibility division.

The above facts and questions arise to us whenever we coordinate for material supply from an outside agency. The above does not preclude the fact that use of dredge spoil in NJDOT projects may be practical for both the Corps and NJDOT in certain areas.

The first input reports I have collected from our various Bureaus have been completely negative, however, with our Area Design Groups and Soils Groups still to hear from, I am hoping we can offer you more when I send you what data we can collect.

Very truly yours,

Samuel C. Whitehead

Samuel C. Whitehead, Project Engineer
Bureau of Special Engineering

IN REPLY PLEASE REFER TO

NJDOT Input -
Delaware River Dredging
Disposal Study

State of New Jersey

DEPARTMENT OF TRANSPORTATION

1035 PARKWAY AVENUE
TRENTON, NEW JERSEY 08625

Russell H. Mullen
[redacted]
Acting Commissioner

May 8, 1978

Lt. Col. Joel T. Callahan
Acting District Engineer
Philadelphia District COE
Custom House, 2nd & Chestnut Streets
Philadelphia, Pennsylvania 19106

Dear Colonel Callahan:

In response to your request for New Jersey Department of Transportation input relative to the projected Regional Dredge Spoil Disposal Study, I have requested all NJDOT Bureaus and Units considered pertinent to respond to the questions posed in your letter of February 23, 1978, to the Commissioner. The NJDOT Bureaus and/or Units solicited covered virtually every known area wherein the use of such soils material as you describe might be a possibility, within NJDOT long-range planning.

As was indicated in Mr. Whitehead's letter to you dated April 18, 1978, the utilization of this type of operation has many limitations as regards its practical use in a NJDOT construction project and, again, as was also indicated, the majority of the responses from our own people are negative. However, at this time, the one area which might be worth your pursuit is the general Trenton Complex Area.

The Trenton Complex Area is made up of a complete arterial loop around the City comprising Route 29 Freeway, Route 95 (Interstate), and Route 295 (Interstate). Unfinished portions of Route 29 and Route 295 remain and will require considerable amounts of Borrow Excavation Zone 2 (underwater fill) and Zone 3 gradations for which dredged spoil might be acceptable. All of this future construction comes under the administrative control of NJDOT Design Area 3.

NJDOT Design Area 3, located at 1035 Parkway Avenue, Trenton, and headed by Mr. Frederick T. Bogdan, Supervising Engineer, I, is responsible for coordination with outside agencies and promulgating the plans of all proposed construction within the Trenton Complex Area. Mr. Bogdan would be available for discussion with you, upon reasonable notice, at the above address. His telephone number is 609-292-8530.

In concert with Mr. Bogdan's responsibilities as described above, Mr. Nicolai Nicu, Chief, Bureau of Soils, is responsible for the recommendation and approval of all soils types and gradation used in all NJDOT projects, including the Trenton Complex. He is located at the Brunswick Avenue Circle just north of Trenton and can be reached at 609-292-3456.

We suggest you contact the above individuals who can fill you in on all the facts regarding the Trenton Complex construction and time frames.

Very truly yours,

Edwin W. Dayton
Assistant Chief Engineer, Design

Encls.

DEPARTMENT OF THE AIR FORCE
REGIONAL CIVIL ENGINEER, EASTERN REGION (HQ USAF)
526 TITLE BUILDING, 30 PRYOR STREET, S W.
ATLANTA, GEORGIA 30303

REPLY TO ATTN OF: ROV2 19 May 1978

SUBJECT: Delaware River Dredging Disposal Study

TO: Philadelphia District/NAPEN-R

1. Upon considering your proposed Delaware River Dredging Disposal Study, we have found the potential for significant impact on the Air Force facilities in the area. The following comments are provided:

a. The dredging of the Delaware is very important to our Air Force installation at Dover because jet fuel for the base is transported up the river by barge. Restrictions on the river channel could interfere with barge traffic and the mission of the base. We request that you consider our requirement to use the river during your study.

b. The selection of dredge spoil disposal sites could also affect Dover AFB. Dredge spoil material dumped in certain areas near our base would attract birds, increasing the potential for Bird/Aircraft Strike Hazards (BASH). The Air Force has completed a study of BASH incidents at Dover AFB and a report is currently being prepared. The report is scheduled for release in June 1978 and we will provide you a copy for information.

c. An Air Installation Compatible Use Zone (AICUZ) Study has been completed at Dover and a copy of the report is attached. The study provides recommendations for land use near the base which is compatible with the operation of the base.

d. Some areas of the base may be suitable for disposal of the dredge spoil, provided that such disposal does not interefere with base operations. If such on-base sites are considered in the study, a thorough evaluation must be made of the potential effect of the disposal activity.

3. We appreciate the opportunity to comment on your study. If we can be of further assistance, please contact Mr. Sherrill W. Shepherd at 404/221-6821.

FOR THE CHIEF OF STAFF

Robert L. Wong
ROBERT L. WONG
Chief, Environmental Planning Division

1 Atch
AICUZ Study

Cy to: HQ USAF/PREV
MAC/DEV
ADC/DEV
NGB/DEC

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
1825B Virginia Street
Annapolis, MD 21401

May 22, 1978

District Engineer
Philadelphia District, Corps of Engineers
Custom House-2nd and Chestnut Streets
Philadelphia, PA 19106

Dear Sir:

The U. S. Fish and Wildlife Service has reviewed information provided in your letter of April 25, 1978, and previous transmittals regarding maintenance dredging in Indian River Bay, Delaware, in the vicinity of Buoy 19A and in the Waterway from Indian River Bay to Rehoboth Bay. This letter constitutes the report of the Service and the Department of the Interior, and is submitted in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U. S. C. 661 et seq.).

Several aspects of the proposed maintenance dredging which are of concern to the Service follow:

1) The Service is reluctant to recommend approval of overboard uncontained disposal in shallow waters. We would prefer to see beneficial use made of the dredged material. For several years, this project has been considered to have potential for marsh creation. The Environmental Impact Statement (EIS) for this project, drafted in the fall of 1973, discussed the potential for marsh creation as a beneficial means of disposal. The Department of the Interior in a letter commenting on the draft EIS (Enclosure 1) and again in a letter dated April 12, 1978, (Enclosure 2) strongly endorsed the concept and application of marsh creation, where appropriate.

   Disposal site B in the current project may also be a potential site for marsh creation. The Section 404 Evaluation Report for the project (page 4) alludes to this fact. The Service recommends that the feasibility of sprigging the disposal site be investigated.

2) Execution of dredging in Indian River Bay during the summer months may result in significant adverse biological and water quality impacts. The summer months are both the most productive months biologically, and the most stressed in terms of water temperature and dissolved oxygen levels. Unconfined overboard disposal operations resulting from hydraulic dredging are generally considered to be taxing to the environment by decreasing light penetration thereby reducing photosynthetic rates, and by increasing the chemical and biological oxygen demand. Ambient dissolved oxygen levels reach naturally low levels in summer months when biological oxygen demand is high and the oxygen holding capacity of the warmer waters is low.

In addition, hard clams (Mercenaria mercenaria), common throughout Indian River Bay, undergo an annual bimodal spawning cycle, generally from early May to late September. Dredging and overboard disposal may interfere with reproduction of this important species.

3) In general, the sediment analyses indicate that the sediments in the channel areas and the disposal sites are compatible. However, one area, site #1, is of significant concern.

The attached table (Enclosure 3) was compiled from the sediment analyses contained in the Section 404 Evaluation Report. With the exception of site #1, sand ranges from 86-99% and silt/clay from 1-9% at every sampled site. At site #1, there is 29% sand and 70% silt/clay. This agrees with information contained in the draft EIS for the project (Figure 4, Sediment Patterns in South Rehobeth Bay and Indian River).

According to information contained in the Philadelphia District's survey of the channel (September 21, 22 and 27, 1977), almost half of the material to be dredged will originate in or near site #1. Deposition of this material at predominantly sandy disposal sites may result in significant species composition changes. If the silt/clay material is stable in the sandy areas, the disposal sites will be recolonized by a different community. Such a shift in community populations should be addressed. If the material will not be stable, another, more suitable disposal site should be located.

4) Another question concerning stability of the disposal sites arises. In the letter of March 28, 1978, from the Delaware Department of Natural Resources and Environmental Control, it is reported that the owner of the South Shore Marina attributed accelerated shoaling to previous overboard disposal activity at site A. The State has agreed ". . .to assume responsibility for removal of shoals attributed to the monitored transported material from the South Shore Marina entrance using the State dredge and preferably overboard disposal in the Indian River borrow area."

The Service is concerned that:

a) There may be significant sediment transport to areas other than the South Shore Marina, specifically biologically sensitive areas (shellfish beds); and,

b) Dredging the same material twice is inefficient and doubly damaging.

The monitoring program planned for this project appears to be very good. We would appreciate being informed of the progress of the monitoring operation. The problem of mercury contamination has been satisfactorily settled based on additional sampling results.

Based on the above discussion, the Service recommends that the following actions be taken in this project:

1) The Philadelphia District consider the feasibility of marsh creation for this project specifically at site B. The Service is willing to participate in site selection;

2) The Philadelphia District consider delaying dredging until after October of this year. In addition to avoiding the biological impacts of summer dredging, some disruption of recreational boating around the dredge apparatus may be avoided;

3) Reconsider the compatibility of sediments in the channel in relation to the proposed disposal sites. Alternate sites may prove more suitable; and,

4) Investigate the plausibility of the contention advanced by the South Shore Marina. If there is a significant possibility of sediment transport, an alternate disposal site should be located.

The District staff has been helpful throughout this project in carrying out the planned sampling program and in furnishing information to this office. The Service requests that the Philadelphia District respond to the concerns raised in this letter. After reviewing this response, we will be in a position to offer a final recommendation.

Sincerely yours,

Glenn Kinser
Supervisor
Annapolis Field Office

Enclosures

On Page 31, what is the basis for the conclusion that the "quantity of material dredged is not great, so the impact should be slight?"

The composition of the dredge spoil is variously said to be "probably quite similar" (Page 31) and "similar" (Page 34) to the bottom material at the disposal site. This matter could be readily determined and the true situation should be described in the final environmental statement as it affects potential movement of the spoil by currents.

From the information given in Figure 3 and on Pages 26 and 28, it appears that overboard disposal of dredged material is accomplished in the delta forming area. (Figure 5 shows overlap of spoil area and tidal delta.) The disposal technique appears to contribute to the problem of shoaling or delta formation. Apparently, this situation is recognized at the top of Page 32 where it is suggested that future spoil disposal methods should be sought to maintain the entire estuary rather than just the channel. We suggest consideration of alternative methods of spoil disposal for this project.

Maintenance of the jetties along each side of the inlet leads to erosion of sand from the beach north of the inlet, as pointed out in the draft environmental statement (Page 34).

We endorse the concept of the creation of new tidal marsh, as described on Pages 36 and 37. We urge you to work closely with the Department and with the Delaware Department of Natural Resources and Environmental Control. Personnel from the State and the Bureau of Sport Fisheries and Wildlife could specify a location and dimensions of a spoil disposal area where new marsh would enhance Delaware's estuarine environment.

The statement does not clearly confirm consultation with the State Historic Preservation Officer: Mr. E. Berkley Tompkins, Historic Registrar, Department of State and Cultural Affairs, Dover, Delaware 19901.

We would recommend that the final statement contain evidence of this consultation to determine whether the project will have a direct or indirect impact on any cultural (historic, archeological, aesthetic) resources.

Sincerely yours,

(Mrs.) Ellen M. Jensen, Acting Special Assistant to the Secretary

cc: UDAO

ER 73/1307

District Engineer
Philadelphia District, Corps of Engineers
Custom House, 2nd and Chestnut Streets
Philadelphia, Pennsylvania

Dear Sir:

This constitutes our review of your draft environmental statement for Indian River Inlet Project Maintenance, Sussex County, Delaware. Our comments were prepared in response to your letter dated October 2, 1973, to Assistant Secretary Larson. Our comments are as follows:

Section II Area Description

On Page 21, Section 2.11, Recreation, Delaware Seashore State Park and Holts Landing State Park are identified as existing park areas receiving substantial use by the public for a variety of recreational opportunities. Burton Island, directly adjacent to the maintenance channel and spoil area, was purchased by the State of Delaware as an addition to the Delaware Seashore State Park with Land and Water Conservation Funds. The anticipated impact of the proposed project is discussed in general terms in Section III, Environmental Impact of the Project. However, no specific reference is made to the expected impact on the aforementioned parks and associated recreational opportunities. It is, therefore, recommended that an appropriate evaluation of these impacts be presented in the final statement.

The statement appears to be a summary of conditions as extracted from appropriate references, thus requiring the reader to search through the literature for the actual supporting data. For example, on Page 20, what facts were used to define "poor water quality", and what data are available to support the comments on septic tank problems?

Section III Environmental Impact of the Project

Adverse impacts of private dredging practices are cited on Page 27. We suggest the statement would be improved if these practices were identified, either as being essentially the result of unauthorized projects, or the result of projects executed under State and/or Federal permits. Whichever the case, we believe the impacts mentioned are deserving of more consideration than passing reference. We, therefore, suggest that it would not be inappropriate to include recommendations in the statement regarding how these problems and adverse impacts could be avoided in the future.

ENCLOSURE 1

APR 1 2 1974

District Engineer
Philadelphia District, Corps of Engineers
Custom House, 2nd & Chestnut Streets
Philadelphia, PA 19106

Dear Sir:

This letter constitutes our report on your proposed plan for maintenance dredging in the Federal navigation project channel in Indian River Bay. The project location is shown on the chart provided with Colonel Selleck's letter of February 20, 1974. It was authorized by the River and Harbor Act of 1937 as amended. Our comments are submitted in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) in cooperation with the Delaware Division of Fish and Wildlife. Their comments will be forwarded upon receipt.

It is our understanding that approximately 30,000 cubic yards of material would be dredged from a segment of the project channel in Indian River Bay. The spoil would be deposited into Indian River Bay to the south of the project channel in a designated area of some 200 acres.

The habitat provided by Indian River Bay in the area to be affected by both dredging and spoil disposal is of significant value for finfish, shellfish, and other invertebrates. Indian River Bay supports large populations of sport and commercial fishes including summer and winter flounder, bluefish, striped bass, menhaden, and weakfish. The most abundant forage species include mummichog, Atlantic silversides, striped killifish, sheepshead minnow, and bay anchovy. The bay serves as a major spawning nursery and feeding area for many sport, commercial, and forage fish.

The bay bottom in the area of the proposed spoil site supports a complex benthic community which includes among its members the hard-shell clam (Mercenaria mercenaria), the doveshells (Anachis translirata and Anachis avara), the Northern dwarf tellin (Tellina agilis), and a variety of amphipods and polychaete worms. These and other marine invertebrates play an essential role in the basic food webs of the estuary supporting valuable fish and wildlife resources.

We have reviewed the project plan and have concluded that the dredging phase of the work will not have significant adverse effects on fish and wildlife resources.

Spoil disposal as planned, however, would have significant adverse effects on the benthic organisms described previously, particularly if spoiling is repeated on a periodic basis. Population levels and species diversity would be greatly reduced in the large area (some 200 acres) which would be buried under spoil. In addition, the decrease in water depth in the spoil area could lower its value as fishery habitat.

In view of these negative impacts, the Bureau recommends that alternative plans for spoil disposal be adopted which could include the following in lieu of the proposed project.

1. Selection of upland sites to contain the excavated material, or

2. Placement of spoil adjacent to Gull Island (or other very shallow zone of the old spoil area), to depths up to, but not exceeding, the mean high water line and vegetating the filled zone with _Spartina alterniflora_. If this recommendation is followed, the exact siting and method of marsh grass planting should be closely coordinated with the Delaware Division of Fish and Wildlife.

The advantages of modification #2 over the proposed plan include the following:

1. Spoil would be concentrated in a smaller area, thus disrupting fewer benthic organisms.

2. An eroding area could be stabilized.

3. Productivity of spoil site selected would be increased through establishment of marsh vegetation.

Sincerely yours,

Richard E. Griffith

Regional Director

cc: UDAO

COMPARISON OF SEDIMENT GRAIN SIZE
INDIAN RIVER BAY*

AREA	SEDIMENT SIZE	
	SAND	SILT AND CLAY
Disposal Area A	96%	1%
Disposal Area B	99%	0.9%
Site #1	29%	70%
Site #2	98%	1%
Site #3	86%	9%
Site #4	96%	1%

* From: Philadelphia District, Corps of Engineers
Section 404 Evaluation Report
Indian River Bay Maintenance Dredging 1978

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
112 West Foster Avenue
State College, PA 16801

June 22, 1978

Colonel Harry V. Dutchyshyn
Philadelphia Corps of Engineers
Custom House, 2nd & Chestnut Streets
Philadelphia, PA 19106

Dear Colonel Dutchyshyn:

This responds to your February 23, 1978 letter to Regional Director, Howard N. Larsen, requesting comments on the authorized Delaware River Dredging Disposal Study. In accordance with our FY78 Scope of Work agreement, this planning aid letter recommends investigations during the course of the study. These views of the Service and the Department of the Interior are prepared and submitted in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

The Federal government annually dredges approximately 8.2 million cubic yards of bottom sediments to maintain navigation channels in the Delaware, Schuylkill and Christina Rivers. Private interests dredge an additional 2.3 million cubic yards each year. The combined total of 10.5 million cubic yards is apportioned as follows: 6.0 million cubic yards from the Delaware River, Philadelphia to the Sea, by government owned hopper dredges; 0.7 million cubic yards from the Delaware River, Philadelphia to Trenton by pipeline dredges under government contract; 0.5 million cubic yards from the Schuylkill River by pipeline and bucket dredges; 1.0 million cubic yards from Wilmington Harbor by pipeline dredges under government contract; 1.1 million cubic yards from the Delaware River and tributaries by private contractors utilizing pipeline dredges; and 1.2 million cubic yards from the Delaware River and tributaries by private contractors utilizing bucket dredges.

Shoaling and subsequent dredging in the Delaware River generally occurs in recurring locations. Major shoaling points are located offshore of Marcus Hook, Pennsylvania; Philadelphia, Pennsylvania; and New Castle, Delaware. These areas account for the majority of the dredging required to maintain the Port of Philadelphia.

Bottom sediment texture and composition varies considerably according to river location. For example, below River Mile 36, bottom sediments are mostly sand with small amounts of finer materials. Above River Mile 36, they are more heterogenous, containing finer-textured mixtures of organic and inorganic materials.

The government owns seven active disposal sites along the Delaware River, Philadelphia to the Sea project, and leases nine more areas in the upriver reach between Philadelphia and Trenton. Together, these 16 sites have an estimated total capacity of approximately 200 million cubic yards. Since six million cubic yards of dredged spoil consume approximately four million cubic yards of disposal site capacity, the present rate of dredging (10.5 million cubic yards per year) is not expected to exhaust the combined disposal site capacity for about 30 years. Unfortunately, disposal site capacity is only one aspect of the disposal problem. Equally important is hauling distance. Currently, an economical hopper dredge haul generally is five to seven miles, while the economic limit for a pipeline dredge is far less. Therefore, even though alternative spoil disposal sites are available, distances from the dredge area often precludes economic use.

The current disposal problem stems from the fact that several of the government-owned disposal sites located conveniently close to repetitive shoaling points are rapidly being filled. The Corps has investigated a variety of solutions, including methods to limit shoaling, extending the life of existing disposal sites, purchase of new disposal areas and transport of dredged material to distant disposal sites. The remainder of our letter addresses each of these potential solutions.

Shoaling in the Delaware River has been attributed to erosion of upland areas and beds and banks of estuaries; changes in the configuration of the bed of estuary; erosion of banks, dredging operations, sewer and industrial effluents, natural organic processes and tidal exchanges. Attempts to minimize shoaling have centered on training dikes to speed flow or induce flushing. Our experience with such devices elsewhere, particularly on the Missouri and Mississippi Rivers, indicates training dikes destroy fish and wildlife habitat by siltation, scouring of the riverbed and banks and increased velocities. We recommend that further study of training dikes in the Delaware River be terminated. As an alternative, we recommend an investigation of methods which reduce sediments to the river, without adversely affecting fish and wildlife resouces. Such a study should take into account the possibility of accelerating the land treatment measures of the Soil Conservation Service.

We also recommend that the study address potential alternatives to maintenance dredging by locating existing and proposed navigation facilities where maintenance dredging could be reduced or eliminated. The long range potential of shifting Wilmington Harbor's orientation from Christina River to the Delaware River could be considered.

The Waterways Experiment Station, Vicksburg, Mississippi has conducted extensive research aimed at prolonging the life of spoil disposal sites. Economically feasible techniques have been developed for drying, separating, treating and reusing spoil material for landfill, strip mine reclamation and production of certain crops. The station has also developed methods for improving spoil dike designs increasing storage capacity. In addition to these techniques and uses, we recommend the District investigate the feasibility of using spoil material in highway construction, and also as fill for abandoned gravel pits and deep mines. The aforementioned techniques and uses should be investigated for both active and inactive disposal sites.

The Waterways Experiment Station has also demonstrated that fresh and saltwater marsh habitat can be successfully established on certain dredged spoil sites. They have developed a systematic set of guidelines for creating marshes under a variety of situations and constraints. These guidelines should be explored in detail for possible use on the Delaware River.

Goose Island, Chester-Monds Island and Tinicum Island are three areas in the Delaware River currently being investigated for suitability as spoil disposal sites. Each of these areas occur between River Mile 80 and 90; the first and second in New Jersey and the third in Pennsylvania. The Chester-Monds Island and Goose Island sites were in advanced stages of design in 1975. Because of local opposition, the Corps does not consider the Tinicum Island site likely for development. The combined disposal capacity of the three sites is approximately 105 million cubic yards.

In a letter from former Regional Director Richard Griffith, to the District Engineer dated November 18, 1974, the Service recommended that Goose Island be deleted from further consideration as a disposal site. Special Assistant to the Secretary, Roger Sumner Babb, in the Department of the Interior's official comments on the draft environmental impact statement, Project Maintenance, Delaware River, Trenton to the Sea and Schuylkill River and Wilmington Harbor Tributaries, reiterated the recommendation that the Goose Island area be preserved. The island provides significant fish and wildlife habitat and the Service and the Department reiterates its recommendation for preservation of the island.

The Chester-Monds Island proposed disposal site contains extensive freshwater wetlands, shallows and deepwater habitat. Biologists from the Delaware River Anadromous Fish Project, a Federal-State Cooperative, report that this river reach experiences near anoxic conditions during summer months due to sewerage and industrial effluents, but supports significant numbers of herring and other sport fishes during the Fall when dissolved oxygen levels increase. The site is also important for waterfowl, wading birds and shorebirds. Because fish and wildlife resources at the Chester-Monds Island site are

significant, and likely to increase in significance if water quality improves, we recommend that plans to use this site for spoil disposal be dropped. Such action would be in keeping with the President's recent Executive Order 11988 for protection of wetlands.

The Tinicum Island area serves as a major waterfowl wintering site in the Delaware River. Like the Chester-Monds Island area, it supports significant numbers of herring and other sportfishes. Again, because of important fish and wildlife resources at the site, the Service recommends against further investigations to determine the suitability of the area for spoil disposal.

We do not wish to discourage efforts to locate new disposal sites adjacent to recurring shoal areas. Mutually acceptable areas may still be discovered. Conveniently placed disposal sites, however, may be in short supply. Emphasis should center on transport of dredged materials over long distances to areas suitable for spoil disposal.

Studies indicate it is feasible to move large amounts of dredge spoil great distances (25-50 miles) by pipeline. Such a system, however, would not be devoid of adverse environmental consequences. However, we would anticipate these consequences would be less severe than loss of wetlands, river shallows and deepwater. We, therefore, recommend that studies be undertaken to locate environmentally acceptable inland disposal sites.

In summary, the Service recommends the District:

1. Terminate the study of training dikes in the Delaware River.
2. Investigate opportunities and methods of reducing sediment input to the river.
3. Address potential alternatives to maintenance dredging by locating existing and proposed navigation facilities where maintenance dredging could be reduced or eliminated.
4. Investigate the feasibility of using spoil material for landfill, strip mine reclamation, crop production, highway construction, and fill for abandoned gravel pits and deep mines.
5. Investigate the use of the Waterways Experiment Station marsh creation guidelines for possible use in the Delaware River
6. Terminate plans to construct the Goose Island, Chester-Monds Island and Tinicum Island disposal sites.
7. Locate environmentally acceptable inland disposal sites.

We appreciate the opportunity to provide comments on the Plan of Study and look forward to working with your staff as planning continues for this study.

Sincerely yours,

Charles J. Kulp

Charles J. Kulp
Field Supervisor

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
1825B Virginia Street
Annapolis, MD 21401

November 15, 1978

District Engineer
Philadelphia District, Corps of Engineers
Custom House, 2nd & Chestnut Streets
Philadelphia, PA 19106

Dear Sir:

This planning aid report is furnished under the terms of the Scopes of Work for FY 1978 and 1979 to assist in the Indian River Inlet and Bay study. It is a preliminary report including a general literature search, endangered species listing, and general discussion of fish and wildlife problems/needs in Indian River Bay.

It is anticipated that a second planning aid report will be submitted in the last quarter, FY 79 evaluating alternative plans on fish and wildlife resource in the Inlet and Bay area.

GENERAL DESCRIPTION OF FISH AND WILDLIFE RESOURCES OF INDIAN RIVER BAY AND INLET

A general description of the natural resources of Indian River Bay is contained in the final environmental impact statements published by the Philadelphia District for maintenance dredging of Indian River Inlet (U. S. Army Engineer District; Philadelphia, 1975) and for the Delmarva Power and Light Company Indian River Power Station (U. S. Army Engineer District Philadelphia, 1977). The latter contains a discussion of the ecology of the bay. This report will not reiterate that information, but will provide a brief discussion of additional information and comments regarding the ecology of Indian River Bay as it relates to this study.

Indian River Bay is an important waterfowl area in southern Delaware. Waterfowl do not move into Indian River Bay in any numbers until November. Black ducks are usually found along the eastern edge of the bay and along the southern edge west to Holt's landing. Canvasbacks, when present, are usually located about 100 yards out along the south shore from Holt's Landing to the power plant at the mouth of Indian River and along the north shore near Oak Orchard. Bufflehead, hooded merganser, goldeneye and scoters are found along all shores of the bay. Brant are usually located at the mouth of Rehoboth Bay and along the eastern edge of Indian River Bay (Whittendale). In Delaware, brant restrict themselves almost exclusively to Indian River and Rehoboth Bays.

The importance of Indian River Bay as a nursery area for significant commercial marine species such as menhaden has been documented (Pacheco, 1975). A description of the ocean fishery off Delaware Bay may be found in Reintjes and Reithmayr (1960). Listings of resident and migrating finfish in Indian River Bay may be found in the previously referenced final EIS's and Derickson (1970) and Campbell (1975). The Bay continues to support a substantial commercial and sport fishery.

Of particular interest are the heavy spawning concentrations of winter flounder (Pseudopluronectes americanus) which occur in Indian River Bay beginning in late January and peaking in mid-February to early March (Delaware DNR & EC; Derickson, 1970).

Active oyster (Crassostrea virginica) and hard clams (Mercenaria mercenaria) beds are located in various portions of the bay. When sites for project alternatives are identified, potential impacts on shellfish beds should be evaluated in detail.

ENDANGERED SPECIES

A list of endangered species taken from Alexander (1978) is found in the table. Any of these species may be found in the Indian River Bay and Inlet area. Peregrine falcons (Falco peregrinus) transit the coastline during annual migrations. The bog turtle (Clemmys muhlenbergi) is normally restricted to the piedmont area of Delaware and is rarely found in the southern part of the state (Arndt, 1978). The range of the Delmarva fox squirrel (Sciurus niger cinereus), an endangered species, is presently thought to be confined to portions of the Delmarva Peninsula in Maryland and Virginia.

Of primary concern in the current project area is the bald eagle, Haliaeetus leucocephalus. Of the four known active nests in Delaware, in 1977-78 one is located along the north shore of Indian River Bay (Abbott, 1978).

Human activity appears to be very disruptive to Bald eagles even when direct disruption or confrontation is relatively rare. It is estimated that bald eagles in the Chesapeake Bay region, including Delaware, suffered a 90% population loss in the last 100 years with a corresponding loss of only about 20% of eagle nesting habitat (Abbott, 1978).

Nesting failures in the 1940's to 1960's resulting from chlorinated hydrocarbon contamination and reduction of adult populations resulting from encroachment by human habitation, egg collecting, hunting, and lumbering severely damaged the Chesapeake Bay region populations.

TABLE

ENDANGERED ANIMAL SPECIES IN DELAWARE POSSIBLY PRESENT IN INDIAN RIVER BAY

Common name	Scientific name
Bald eagle	*Haliaeetus leucocephalus*
Peregrine falcon	*Falco peregrinus*
Brown pelican	*Pelecanus occidentalis*
Short-nosed sturgeon	*Acipenser brevirostrom*
Atlantic leatherback	*Dermochelys coriacea coriacea*
Atlantic Ridley	*Lepidochelys kempi*

Following this severe decline, the Delaware bald eagle population appears to be slowly increasing.

Fish of various kinds furnish the eagle's main food supply which is augmented by small mammals, smaller birds, and carrion (Bent, 1961).

The most acute period of sensitivity to human disturbance is during the nesting season (D'Loughy, pers. comm.). In the Chesapeake Bay region egg laying occurs primarily during February. In normal years most young birds fledge by late June (Abbott, 1978).

In order to avoid disruption of nesting activities and fishing, any proximate dredging or filling operations should be avoided between February and July of the project year for protection of this species. The status of the nest (active, abandoned) should be ascertained prior to actual dredging as this variable may change from year to year.

When project specifics such as dredge and disposal sites become available, their impacts on endangered species should be reevaluated. This report does not satisfy consultation requirements of Section 7 of the Engangered Species Act.

FISH AND WILDLIFE NEEDS/PROBLEMS

There are several areas of concern for Indian River Bay's fish and wildlife resources which should be addressed. Some of these may affect the perspective of the study and resultant recommendations.

Of great concern to the U. S. Fish and Wildlife Service are the ecological alterations which are occuring in Indian River Bay. Some of these are acute, obvious and intentional changes such as lagoon developments, while others are chronic, subtle and not easily recognized or understood, such as nutrient enrichment and sedimentation. Several investigators (Casey, 1976; Daiber, et. al., 1974) have described the detrimental environmental impacts of irresponsible shoreline development. Most damaging of these developments are the lagoon systems resulting from dredging and filling of wetlands. Campbell (1975) reported that up to 50% of the non-wooded wetlands in some tributaries to Indian River Bay had been eleminated in the past by this type of development. It is expected that this scourge of the Bay's resources is a fact of the past.

However, it is possible that the present project is being studied largely to explore the need for creating or improving water access to these developments which have markedly reduced the quality of Indian River Bay. Therefore, the question must be addressed, will expansion of the Federal channel induce further development in Indian River Bay, further degrading the Bay's resources?

More difficult to evaluate are the subtle long-term effects of changes in the Indian River region. An excellent example of past problems is the closure of oyster beds in Indian River due to bacterial contamination. Land use changes with attendant secondary impacts, including power plant construction, bacterial contamination, increased sedimentation, piece-meal alteration of shorelines and increased boating activity are probably affecting the Bay as seriously as more visible actions but on a temporally extended scale. Any contribution of the subject project to these environmental degradations should be carefully weighed. In evaluating this type of impact, one can not at all times rely on documented scientific evidence for definition of the magnitude of impact. Trend analysis, combined with an understanding of the ecological factors involved and field data, when available, may be a reliable method of estimating long-term, chronic impacts. One then must balance these impacts against the capability of the ecosystem to withstand alterations without a major shift in the character of the natural system. Carter (1978), in attempting to convey the complexities of understanding man's alterations of ecosystems, has developed the following idea to test the impact of a proposed project; "have the (natural resources) been adequately protected so that ecosystem integrity is assured of having a buffer sufficient to satisfy ignorance of its requirements?"

In summary, in view of the substantial ecological alterations already inflicted on Indian River Bay, the Service believes that the present study should carefully weigh the secondary and long-term impacts of the alternatives as they are developed, keeping in mind the finite character of the existing ecosystem. Mitigation of unavoidable adverse impacts should be considered early in the study. Such options include marsh creation, time of year restriction, and treatment of upland disposal sites to maximize their value to fish and wildlife.

PROPOSED FURTHER FISH AND WILDLIFE SERVICE ACTIONS

Per the Scope of Work for FY 1979, the Service will provide a Planning Aid Report evaluating alternative plans on fish and wildlife resources in the Inlet and Bay area. This analysis will include site descriptions, shellfish and finfish impacts, site proximity to endangered species, and enumeration of other factors such as sediment compatability, contamination potential and possible mitigative measures.

Sincerely yours,

Glenn Kinser

Glenn Kinser
Supervisor
Annapolis Field Office

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NAPEN-R

11 MAY 1979

Honorable Daniel J. O'Hern, Commissioner
New Jersey Department of Environmental
 Protection
P. O. Box 1390
Trenton, N.J. 08625

Dear Mr. O'Hern:

The Philadelphia District is currently conducting the Delaware River Dredging Disposal Study. The purpose of this Congressionally authorized study is to develop a regional dredging spoil disposal plan for the tidal portions of the Delaware River, its tidal tributaries, and Delaware Bay, extending from Trenton, New Jersey, to the sea and Indian River Inlet and Bay. This study was initially authorized by the United States Senate Committee on Public Works on 20 September 1974 and extended to include the Indian River Inlet and Bay area on 24 July 1978.

The goals of the Delaware River Dredging Spoil Disposal Study will be to develop a regional dredging spoil disposal plan for the Delaware River, its tidal tributaries, Delaware Bay, and Indian River Inlet and Bay; and to designate specific sites which may be used, with minimum degradation of the natural environment, by both the public and private sectors for the disposal of dredging spoil during the next ten years and the identification of potential sites which may be used for this purpose thereafter.

The study is expected to include investigations of the following: current and future dredging requirements of Federal, State and private interests; potential future spoil disposal sites; alternative dredged spoil disposal and utilization techniques; establishing land use demands among agricultural, industrial, environmental and navigational interests; and economic, environmental and social impacts of all potential alternatives. The study will also access the current and projected future problems associated with present dredging disposal methods and include an active public involvement and participation program.

B2201

NAPEN-R
Honorable Daniel J. O'Hern

We wish to maintain a continuous program of active participation with the State throughout this study. As a result, an expression of your interest in this study and your views regarding the significance of the dredging disposal problem in your State would be appreciated. We also request that an individual be designated as the coordinator for the State. This person should be able to provide State policy guidance, available technical information, and other assistance.

We look forward to your reply and will inform you of significant developments as the study progresses.

Sincerely,

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

M/R:
Similar letters sent to Honorable Clifford L. Jones, Secretary PA Dept. of Environmental Protection and Honorable Austin P. Olney, Secretary DE Dept. of Natural Resources and Environmental Control.

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
OFFICE OF THE COMMISSIONER
P. O. BOX 1390
TRENTON, N. J. 08625
609-292-2885

May 17, 1979

James G. Ton, Colonel
Corps of Engineers
District Engineer
Department of the Army
Custom House
2nd & Chestnut Streets
Philadelphia, Pennsylvania 19106

Dear Colonel Ton:

Thank you for your recent letter regarding the Delaware River Dredging Disposal Study. The State of New Jersey has an important interest in maintaining the navigable waterways that the Study will focus on and also in insuring suitable disposal of the spoiled material that must be dredged to maintain navigation. Therefore, we see the Study as a most important effort and wish to be appropriately involved.

To that end, I am designating Mr. Lawrence Schmidt, the Chief of the Office of Environmental and Historical Review, as this State's coordinator for your Study effort. Mr. Schmidt can be reached at the above address; his phone number is (609) 292-2662.

Sincerely,

Daniel J. O'Hern
Commissioner

COMMONWEALTH OF PENNSYLVANIA

DEPARTMENT OF ENVIRONMENTAL RESOURCES
P. O. BOX 1467
HARRISBURG, PENNSYLVANIA 17120

In reply refer to
RM
6-A.1

The Secretary

May 25, 1979

Col. James G. Ton
District Engineer
Philadelphia District - Corps of Engineers
Custom House - Second and Chestnut Streets
Philadelphia, PA 19106

Dear Colonel Ton:

I read with interest your letter of May 11, 1979, advising that the Philadelphia District, Corps of Engineers, is currently conducting the Delaware River Dredging Disposal Study authorized by the U. S. Senate Committee on Public Works on September 20, 1974 and extended to include the Indian Rivers Inlet and Bay area on July 24, 1978.

As you are aware, the Commonwealth has a significant interest in this study because of its responsibility to provide spoil disposal areas for the maintenance dredging of the Delaware River Navigation Project, Philadelphia to Trenton, in accordance with the requirements of House Document No. 358, 83rd Congress, Second Session, 1954.

As we proceeded to fulfill our commitment under the above referenced document, we have become very much aware of the unavailability of new spoil disposal areas as the old ones became filled to capacity. Once the currently available riverside disposal areas are filled, which could occur in less than ten (10) years, we foresee many problems and great expense in providing sites on which to place future dredged materials.

Many of the types of areas used in the past, which were so conveniently located near the river, would probably not be approved today because of the environmental impact posed by dredged spoil disposal. The exclusion of these environmentally sensitive areas from use for this purpose significantly reduced the availability of riverside disposal sites.

Another problem, still unresolved, which causes us much concern is the Corps' reinterpretation of non-Federal responsibilities as previously interpreted and executed by both the Corps and the Commonwealth under provisions of House Document

No. 358. The immediacy of the Corps' demand for the substantial fund of $140,000., particularly when such funds are not available in the current year's budget and cannot be made available in next year's budget, is overwhelming. We realize that the solution of this problem is not one of the goals of the Delaware River Dredging Spoil Disposal Study. However, we are sure this matter will have a significant impact upon whether or not the recommendations of the study can be initiated.

I am designating Mr. Norman G. Kapko as the coordinator for the Commonwealth in this Study. Please provide Mr. Kapko with a copy of the authorizing document for this Study and a copy of any reports available to date. He can be contacted by telephone at (717) 787-2315.

Your courtesy in inviting us to participate in the Delaware River Dredging Spoil Disposal Study is very much appreciated.

Sincerely,

Clifford L. Jones

CLIFFORD L. JONES

STATE OF DELAWARE
DEPARTMENT OF NATURAL RESOURCES
& ENVIRONMENTAL CONTROL
EDWARD TATNALL BUILDING
P.O. BOX 1401
DOVER, DELAWARE 19901

OFFICE OF THE SECRETARY

PHONE: (302) 678 - 4403

June 6, 1979

Colonel James G. Ton
District Engineer
Department of the Army
Philadelphia District, Corps of Engineers
Custom House - 2 D & Chestnut Streets
Philadelphia, Pennsylvania 19106

RE: NAPEN-R

Dear Colonel Ton:

Your letter of May 11, 1979 discussed the Congressionally authorized study to develop a regional dredging disposal plan for the tidal portions of the Delaware River and the Indian River Inlet and Bay.

We consider the study of major significance to Delaware since much of our coastline has significant areas of wetlands bordering the Delaware River and Bay and most of its tributaries. The current emphasis on tourism and its attendant recreational boating has focused attention on our waterways, most of which presently or ultimately will require dredging.

The spoil disposal problem is of special significance because of the large areas of wetlands and also because of an intensive agricultural program in the coastal plain along with the increasing number of marinas and housing developments.

I have designated William R. Ratledge, Director of the Division of Soil and Water Conservation to serve as the coordinator for the State.

Sincerely,

Austin P. Olney

Austin P. Olney
Secretary

APO:WRR:jhb

cc: Mr. William R. Ratledge

CONCERNED PUBLICS CORRESPONDENCE

521-0660

THE

ANCHORAGE

MARINA

Front & Jansen Streets

Essington, Pa. 19029

March 2, 1978

Department of the Army
Phila. District, Corps of Engrs
Custom House
Second & Chestnut Streets
Philadelphia, Pa. 19106
Attn: Joel T. Callahan

In response to your letter of February 23, 1978, the marinas located on the Delaware River behind Little Tinicum Island in Essington, Pa. have a major problem due to the lack of dredging. I have no solution to your problem of where the dredging disposal should be done, but we do know that if dredging does not take place every 4 to 5 years in our area, then there will be no marinas or recreational boating. Each year we lose to the mud a half dozen slips. It is useless for any one marina owner or even all marina owners to dredge their areas in that the mud is coming down river and is settling along all the banks.

We would appreciate anything you can do for us in this regard.

Sincerely,

William L. Robinson

William L. Robinson
Owner

WLR/lar

DORCHESTER INDUSTRIES, INC.

March 3, 1978

Department of the Army
Philadelphia District, Corps of Engineers
Custom House, 2nd & Chestnut Sts.
Philadelphia, Pa. 19106

ATTN: Joel T. Callahan, Lt . Colonel

RE: NAPEN-R Letter dated 2/23/78

Dear Sir:

A copy of referenced letter to the mayor of Millville, New Jersey was sent to me for comment. Please be advised that we are extremely interested in anything that effects the lower Delaware Bay, Maurice River and the Maurice River Cove areas.

We are interested through our shipyard in the deepening of the Maurice River, especially with the expected oil boom coming of the New Jersey coast. However, we also operate one of the largest oyster companies in the United States and are concerned that the ecological balance in the lower Delaware Bay be preserved.

We would appreciate being advised of any plan of action or disaction you intend to take in regards to this area, so that we might have the opportunity to comment.

Very truly yours,

Robert L. Morgan

Robert L. Morgan
Vice-President

RLM/jh

B-208

TOWNSHIP OF MOUNT HOLLY N.J.
1677

JOSEPH D. WEBER, JR., *Mayor*
W. DOUGLAS GSELL, *Deputy Mayor*
V. THOMAS FOOKS, *Councilman*
GRACE B. DONNELLY, *Councilwoman*
RUSSELL R. REGN, *Councilman*

23 Washington Street · 08060

Telephone: 609 · 267 · 0170

ROBERT F. CASEY, *Township Manager*

March 6, 1978

Mr. Joel T. Callahan
Lieutenant Colonel, Corps of
Engineers
Custom House - 2D & Chestnut Streets
Philadelphia, PA 19106

Re: Delaware River Dredging
Disposal Study

Dear Colonel Callahan:

In response to your letter of February 23 concerning the above program, the following information is provided:

1. Mount Holly Township believes that there is a very definite need for dredging in the Rancocas Creek. Through a joint program in 1975 (the Township and the Corps of Engineers) that portion of the N. Branch in our community was dredged for flood control purposes. However, the lack of capacity downstream from Mount Holly adversely affects the capacity of the stream in our area.

2. The Township utilized the spoil from the local dredging programs for fill in various parks. We believe that similar uses could be found in other areas and, if hydraulic dredging is properly performed, the impact upon adjacent development is minimal.

Yours truly,

Robert F. Casey
Township Manager

llc

Arnold W. Webster
Assistant Superintendent

BOARD OF EDUCATION
Recreation Department
7th and Cooper Streets
Camden, New Jersey 08102

William J. Lyons
Director of Recreation

March 6, 1978

Joel T. Callahan
Lt. Col. Corps of Engineer
Acting District Engineer
Dept. of the Army
Custom House 2D & Chestnut St
Philadelphia, Pa. 19106

Dear Sir:

The Recreation Department of Camden City is pleased that your department has initiated the Delaware River Dredging Disposal Study.

In the City of Camden there are two major concerns which affect our recreational programming.

1. The flooding of the Cooper River - thus making open space in Farnum Park unplayable.

2. The flooding of the Newton Creek which backs up into Collingswood and Woodlyne. There is open space along Newton Creek which could use fill and become park and open space for our residents.

I would suggest that the disposal of the materials dredged from the Delaware be used to build up the banks of the Newton Creek and the Cooper River. This dredged material could then be seeded and become open space and park land.

I would suggest that you contact the State Highway Department of New Jersey, the Office of Community Development, City of Camden, the Camden County Park Commission and this office to begin planning for this worthwhile and necessary project.

Cordially yours,

William J. Lyons

William J. Lyons
Director of Recreation

cc: Dr. A. W. Webster

WJL:sd

B-210

Clifton Matthew
Supervisor of Recreation

John E. Gilliams
Coordinator of Community Services

BENSALEM TOWNSHIP
BOARD OF SUPERVISORS

639-2500

3800 HULMEVILLE ROAD CORNWELLS HEIGHTS, PA. 19020

OFFICE OF: Township Manager

March 9, 1978

Lieutenant Callahan
Department of the Army
Philadelphia District, Corps of Engineers
Custom House-2D & Chestnut Streets
Philadelphia, Pennsylvania 19106

Dear Lieutenant Callahan:

In response to your recent letter wherein you state you are making a study to develop a regional dredging spoil disposal plan for the tidal portions of the Delaware River;

Bensalem Township is plagued with flooding of the Neshaminy Creek, the Poquessing Creek and the Delaware River; therefore, although we are in support of dredging, we must object to any dumping in our H.U.D. established flood plains.

Your consideration and cooperation will be appreciated.

Very truly yours,

Natalie A. Strange

Natalie A. Strange

NAS/pw

cc: Board of Supervisors

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March 13, 1978

Lt. Colonel Joel T. Callahan
U.S. Army Corp. of Engineers
Customshouse, 2nd & Chestnut ST.
Phila. Pa. 19106

Dear Sir:

This letter will refer to yours of Feb. 23, 1978 NAPEN-R or N2404002 concerning Delaware River Dredging Disposal Study.

I am deeply concerned that such a study be made and finalized as quickly as possible and at this time the findings be funneled into proper area's for active assistance (work to be done)in dredging and spoil area's, for I assure you there is desperate need for both throughout the Delaware Valley.

Please make this letter a part of the record and keep me informed of future developments.

If I can assist in further development of this program to bring about a faster reality of work done please contact me imediately, my qualifications for assistance stem from 39 years part owner of Dredge Harbor Yacht Basin in the Delaware Valley on the Delaware River.

Sincerely yours,

William R. Parsons
WRP:fg
cc:Joseph Kane, Delran Administrator

THE ACADEMY OF NATURAL SCIENCES

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March 13, 1978

Joel T. Callahan
Lieutenant Colonel
Corps of Engineers
Department of the Army
Custom House - 2nd & Chestnut Sts.
Philadelphia, PA 19106

Dear Colonel Callahan:

Thank you for your notification of February 23 on the Delaware River Dredging Study. We are very much interested in this program and appreciate the opportunity to remain aware of its progress. As you may know, we have been involved in a great number of biological studies on the Delaware and we maintain continuing interest in significant activities affecting the river.

Information regarding progress on the study would certainly be appreciated and we would be pleased to comment whenever appropriate.

Sincerely,

J L Peterson

James L. Peterson
Acting Director
Division of Limnology and Ecology

JLP:sd

THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA · NINETEENTH AND THE PARKWAY · PHILADELPHIA, PA 19103

NATIONAL AUDUBON SOCIETY

MID-ATLANTIC REGIONAL OFFICE

P.O. BOX 4181 • HARRISBURG, PA. 17111 • (717) 939-9844

14 March 1978

Lt. Col. Joel T. Callahan
Corps of Engineers, Acting District Engineer
Custom House-2D & Chestnut Streets
Philadelphia, PA 19106

Dear Sir:

I was pleased to learn that your district has initiated the Delaware River Dredging Disposal Study. Certainly a comprehensive study of this nature, at this time will go a long way toward alleviating the potential environmental destruction which could occur as a result of dredging operations.

Prior to assuming the responsibilities as regional representative for the Mid-Atlantic region, I served the Society as a warden/biologist at the Tampa Bay Wildlife Sanctuaries. While there, I served on the Army Corps of Engineers (Jacksonville District) Ad Hoc Advisory Committee for the Tampa Harbor Deepening Project, as well as the Environmental Advisory Committee for the Tampa Port Authority. A major role of these committees was to provide input of an environmental nature to dredging activities in the Bay. In addition, I have had contact and am aware of the Waterways Experiment Station (Vicksburg, Mississippi) programs over the last few years and, in fact, served as a sub-contractor on two of their wildlife habitat projects.

I am very much interested in contributing and assisting you with your study on the Delaware River. I would appreciate you sending me any information whereby my input could be of service.

Thank you for providing this opportunity to work together toward a comprehensive dredging disposal plan for the Delaware River.

Sincerely,

Frank Dunstan

FRANK DUNSTAN
Representative

FD:lg

Getty

Getty Refining and Marketing Company | Delaware City, Delaware 19706 • Telephone (302) 834-6000

March 15, 1978

Colonel Joel T Callahan
Department of the Army
Philadelphia District, Corps of Engineers
Custom House - Second and Chestnut Streets
Philadelphia, Pennsylvania 19106

Dear Sir:

Reference: Delaware River Dredging Disposal Study

We were very pleased to see the February 23 announcement that the Corps has initiated the Delaware River Dredging Disposal Study. We agree that the study followed by action is very much needed.

We note that as the study progresses, you plan to inform interested parties of major developments.

May I request that you put me on the mailing list for announcements.

Thank you.

Sincerely,

W J Adams

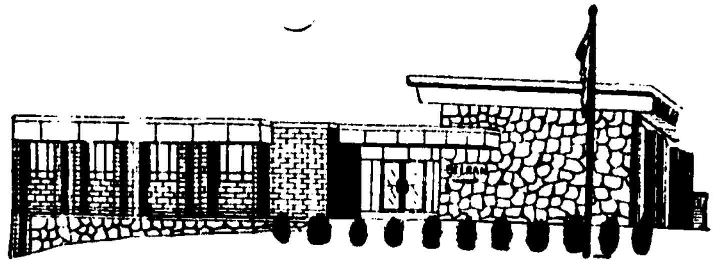
W J Adams
Chief Engineer

SKELLY Skelgas

Township of Delran

BURLINGTON COUNTY, N. J.

CHESTER AVENUE, DELRAN, NEW JERSEY 08075
TELEPHONE: 609-461-7734



March 15, 1978

Joel T. Callahan
Lieutenant Colonel, Corps of Engineers
Acting District Engineer
Custom House - 2nd & Chestnut Streets
Philadelphia, Pa. 19106

Dear Colonel Callahan:

I have your letter dated 23 February 1978 concerning the Delaware River Dredging Disposal Study. The Township of Delran is very interested in this study and feel we have vital input to make regarding areas that will need to be dredged as well as existing and potential spoil areas on and adjacent to the Delaware River.

As a result of your correspondence, I have met with the various marina owners located in Delran Township who advised there are critical areas along the Delaware in Delran Township that warrant evaluation. The owners expressed to me and I forward to you both their and my concern for the necessity of having input in the study from its very inception. Consequently, I would hope that the Corps of Engineers will provide Delran Township the opportunity of being involved with this study from its very beginnings. Myself and the marina owners would like to meet with a qualified representative of the Corps to delineate our mutual concerns at your earliest possible convenience. We feel the input we can offer will provide your office with significant considerations and materials from the very stepping-off of the project.

In conclusion then I would again thank you for the correspondence and for keeping Delran advised as to what is going to be happening and would again

more

Joel T. Callahan
Lieutenant Colonel
Army Corps of Engineers

March 15, 1978

express our request to meet with representatives of your office at your earliest convenience.

If you have any questions, feel free to contact me.

Sincerely,

Lorraine Schmierer

Lorraine Schmierer
MAYOR

LS/ab
cc: Delran Marina Owners
Township Administrator

LAW OFFICES
FALCIANI & DIMUZIO
35 SOUTH BROAD STREET
P. O. BOX 379
WOODBURY, N.J. 08096
(609) 845-8333

ANGELO J. FALCIANI
KENNETH A. DIMUZIO
LOUIS D. FLETCHER
JOSEPH J. HOFFMAN JR

March 16, 1978

Joel T. Callahan
Lieutenant Colonel
Corps of Engineers
Acting District Engineer
Department of the Army
Custom House--2 D & Chestnut Streets
Philadelphia, PA 19106

Re: NAPEN--R

Dear Lieutenant Colonel Callahan:

I am solicitor in Greenwich Township. In reference to the above, please be advised that we have gone on record in Greenwich Township as opposing any dredging project which will deposit dredge spoils in the flood storage basin for the Repaupo Creek Watershed. Rather than detail the history of our opposition to you in a letter, I would appreciate your representative contacting me at my office so that we may review the matter in its entirety.

Additionally, you should be aware that recently during a storm in February, 1978, there was severe flooding along Flood Gates Road which may, in part, have been attributable to the filling in of the flood storage basin with dredge spoils. I respectfully request that this matter be investigated by your office to determine whether such a relationship exists between the recent flooding and the deposition of dredge spoils in the Repaupo Creek Watershed area.

Your prompt response will be deeply appreciated.

Very truly yours,

Kenneth A. DiMuzio

Kenneth A. DiMuzio

KDM:sha

NEW JERSEY
467-1716

BRIDGEPORT BOAT YARD

BRIDGEPORT, NEW JERSEY 08014

Corps of Engineers
Custom House, 2 D & Chestnut Sts.
Philadelphia, Pa., 19106

Attn: Joel T. Callahan

In response to your letter of Feb. 23, 1978, I'm pleased that the Army Corps of Engineers is interested in a regional dredge spoil disposal site for the tidal portions of the Delaware River. We relate to this situation because it affects our daily lives here along the Raccoon Creek. At this time and in the future we will cooperate with the Corps in any way possible.

The assessment of current and projected future problems associated with the Raccoon continually point to the mouth of the creek. If the jetty at the entrance were to be repaired, this would reduce the number of dredgings that would be needed in the future. This repair would also minimize the adverse affect to industrial, environment l and navigational interests in our area. Many private and commercial groups in area have continually expressed their concern about this problem.

As the study progresses, if there are any public meetings or hearings concerning the matter, we would like to attend. We look forward to your assistance in this urgent matter.

Sincerely yours,

CONRAIL

March 20, 1978

SUBJECT: Delaware River Dredging Disposal Study

District Engineer
Department of the Army
Corps of Engineers
Custom House - 2nd and Chestnut Streets
Philadelphia, PA 19106

Dear Sir:

We note with interest your letter of February 23, 1978 announcing the initiation of the Delaware River Dredging Disposal Study, and describing its aims.

As you know, Conrail has many waterfront installations in the Delaware Basin and dredging and dredged spoil disposal represent a significant continuing item of expense to our port activities.

Your invitation to participate in this study is welcomed and we will be happy to lend all possible assistance towards its successful completion.

Very truly yours,

J. T. Sullivan, P.E.
Chief Engineer -
Design & Construction

19th Floor

(215) 893-6061

COMMISSIONERS:
THOMAS C. ROBERTS
President
JOHN FICONDO
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LAKIN C. HENSLEY
WILLIAM J. REED
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LOUIS A. ROBINSON
Treasurer and Tax Collector
MRS. LOUISE LUZAK
Secretary
PETER J. NOLAN
Solicitor
CHARLES J. CATANIA
Engineer

Township of Upper Chichester

County of Delaware,

P. O. Box 2136, Boothwyn, Pa. 19061

FRIENDS MEETING HOUSE

Erected 1769 to replace the original log cabin meetinghouse built in 1703 and destroyed by fire December 4, 1768; probably the only one in the state standing in its original condition and retaining its size and atmosphere.

PHONE: HU 5-5881

March 20, 1978

Department of the Army
Philadelphia District, Corps of Engineers
Custom House - 2nd & Chestnut Sts.
Philadelphia, Pa. 19106

Re: NAPEN-R

Attention: Lt. Colonel Joel T. Callahan
Acting District Engineer

Dear Lt. Colonel Callahan:

In regards to your recent letter concerning the dredging in the Delaware River, such an operation has a far reaching effect on the health and safety of a number of people in Upper Chichester Township.

In the years of 1971 and 1973, during flooding, we suffered considerable property damage in the areas of Marcus Hook Creek and Naamans Creek, both tributaries that flow into the Delaware River and are affected by the tide water. Thanks to the work done in a combined effort by the Army Corps of Engineers, Civil Defense, Department of Forest and Waters, now Environmental Resources, the creeks have not gone over their banks since. For this, we are grateful.

The purpose of this letter is to make you further aware that in Upper Chichester, we cannot drop our guard, and respectfully request that studies be made of our situation, with the thought of updating these improvements and including them in your program.

It's good to hear from you, and we look forward to your reply and your continued positive support.

Sincerely,

Thomas C. Roberts

Thomas C. Roberts
President
Board of Commissioners

TCR:11

B-221

TOWNSHIP OF

Cherry Hill

820 MERCER STREET • CHERRY HILL • NEW JERSEY 08002

Maria Barnaby Greenwald, *Mayor*
Bernard A. Platt, *Deputy Mayor*
Howard S. Gall, *Councilman*
Dr. Joseph M. Hassman, *Councilman*
Col. H. N. Holt. USAF (Ret'd), *Councilman*
Donald E. Dalgleish, *Councilman*
Dr. John A. Rocco, *Councilman*

Lewis M. Weinstein, *Township Manager*

Administration
(609) 665-6500

Public Safety
(609) 665-1200

March 21, 1978

Lt. Colonel Joel T. Callahan
Acting District Engineer
Dept. of the Army - Corps of Engineers
Custom House - 2nd & Chestnut Streets
Philadelphia, Pa. 19106

Re: Delaware River Dredging Disposal Site

Dear Sir:

The Township of Cherry Hill is aware of only one area of the Township that would fall under your proposed dredging disposal study. That area includes the South Branch of the Pennsauken Creek, from the northwest corner of Cherry Hill to the vicinity of Route 38 & Church Road. The Township is concerned with respect to the tributary streams which enter into the South Branch of the Pennsauken Creek as well as the Cooper River and its tributaries to the North Branch of the Cooper River located on the South side of Cherry Hill, as it relates to the spoil material from dredging projects. The cost for removal of dredging material is becoming excessive as the haul distances become greater that will accept this type of material. The Township also recognizes that there is a definite need to have periodic dredging take place in order to maintain the capacity of the channel. With the high amount of organic material normally found in dredging spoil material, perhaps some consideration should be given to composting this material with sludge, leaves etc. as a resource recovery alternative.

We would be interested in knowing the periodic progress of your findings in this study.

Very truly yours,

DEPARTMENT OF PUBLIC WORKS

Richard E. Rohrbach
Township Engineer

RER:ve

B-222

KAIGHN SMITH, M. D., LTD.
SUITE 433
LANKENAU MEDICAL BUILDING
PHILADELPHIA, PA 19151

KAIGHN SMITH, M. D
DANIEL C. HARRER, M. D
JULIA A. CLARK, C. N. M

OBSTETRICS AND GYNECOLOGY
MIDWAY 9-5034

March 28, 1978

Lt. Col. Joel T. Callahan
Acting District Engineer
Department of the Army
Philadelphia District Corps of Engineers
Custom House - 2nd & Chestnut Streets
Philadelphia, PA 19106

RE: NAPEN-R

Dear Colonel Callahan:

As Rear Commodore of the Corinthian Yacht Club of Philadelphia, I am in receipt of your letter regarding the congressionally authorized study to develop a regional dredging spoil disposal system for the tidal portions of the Delaware River, its tributaries, and the Delaware Bay.

The Corinthian Yacht Club would be very happy to cooperate in any way with the Corps of Engineers in a pilot project of your choosing. As you probably know, the basin at the Corinthian Yacht Club was in recreational use in a very significant way until approximately 25 years ago when the silting became so severe that it is now dry at low tide. The Yacht Club, of course, is anxious to dredge out the basin, but recognizing the probability that it would silt in again within a few years has prevented us from taking on the expense. It has always made sense to the membership that if the dredging of the channel between Tinicum Island and Essington could be accomplished and the dredged material make a causeway between the mainland and Tinicum Island, that the silting would not continue to take place and the basin and the channel would remain open once and for all.

The Corinthian Yacht Club, of course, is anxious to have its basin opened, but also would be interested in any experimental approach to the problem that the Corps of Army Engineers might wish to undertake in our area. You probably know that the West End Boat Club will move its facilities to the property next door to the Corinthian. This means that approximately half a mile of shoreline will be given over to recreational use if one includes the West End Boat Club, the Corinthian Yacht Club, the Govenor Printz Park, and the marinas to the north of that until one approaches the Lester plant of Westinghouse Corporation. It would seem important that this area be preserved for this important social impact and because the Corinthian Yacht Club is directly in the middle of this area, its basin and surrounding riparian shoreline should be ideal for the Corps of Engineers studies.

We will assist you in any way that we can in this regard, and would be happy to meet with you at anytime it would be convenient.

Sincerely yours,

Kaighn Smith

Kaighn Smith, M.D., Rear Commodore
Corinthian Yacht Club

KS/agj

Wildlife Management Institute

709 Wire Building, 1000 Vermont Ave., N.W., Washington, D.C. 20005 • 202 / 347-1774

DANIEL A. POOLE
President
L. R. JAHN
Vice-President
L. L. WILLIAMSON
Secretary
IRA N. GABRIELSON
Board Chairman

Northeastern Representative
Philip Barske
200 Audubon Lane
Fairfield, Connecticut 06430

March 28, 1978

Col. Joel T. Callahan, Corps of Engineers
Department of the Army - Philadelphia Dist.
Custom House, 2d and Chestnut Streets
Philadelphia, Penna. 19106

RE: Delaware River Dredging Study-

Dear Colonel Callahan:

Your letter describing the study to develop a regional spoil disposal plan for the Delaware River System has come to me from our Washington office.

Although there are many involvements of the study that I shall attempt to keep abreast of, I am particularly interested in the potentials of using dredge-spoil to develop new marshlands.

During the past few yeats I have carefully followed the work of the Dredged Material Research at Vicksburg and I think we have reached the stage where a portion of the dredge-material may well be utilized to attempt to restore some of the lost wetlands of the Delaware River System.

Sincerely,

Philip Barske

Philip Barske
Northeastern Representative

YAPEWI AQUATIC CLUB

BORDENTOWN - ON - THE - DELAWARE

ORGANIZED 1892

March 29, 1978

Lt. Colonel Joel T. Callahan
Department of the Army
Philadelphia District, Corps of Engineers
Custom House - 2D & Chestnut Streets
Philadelphia, PA 19106

Dear Colonel:

Your letter of 23 February, 1978, states, in part, "The Study is expected to include investigations of the following: current and future dredging requirements of Federal, State and private interests;" Our members navigate and moor their boats on Crosswicks Creek, Bordentown, NJ. In recent years, the Channel of the Creek has silted-in to the extent that the depth at low tide in many areas of the Channel is less than 18 inches and is not navigable by many of our members' boats.

If my memory serves me correctly, the channel has not been dredged in five years. Your inclusion of dredging requirements in Crosswicks Creek, shall be appreciated.

We look forward with interest to the activities of the Corps in this matter.

Very truly yours,

L D Jones

L. D. Jones, Secretary
1467 Makefield Road
Morrisville, PA 19067

215-295-0435

New Castle County
Department of Parks and Recreation

Mary D. Jornlin
County Executive

Ralph S. Cryder
Director

Banning Park, 102 Middleboro Road
Wilmington, Delaware 19804

(302) 571-7700

April 6, 1978

LTC Joel T. Callahan
Acting District Engineer
Philadelphia District, Corps
of Engineers
Custom House - 2 D & Chestnut
Streets
Philadelphia, PA 19106

Dear Sir:

I have received your letter of February 23rd concerning the Delaware River Dredging Disposal Study.

Since our department controls several parcels of land on the Delaware River shoreline, we are keenly interested in any plans that you may develop as a result of your study. We would appreciate being kept informed of any future developments and having an opportunity to provide any input that you feel we could offer. We are particularly interested in the possibility of using a portion of our Fox Point Park as a potential disposal site for your operations.

If you should have any questions or desire additional information on this proposal to use Fox Point Park, please feel free to contact me.

Sincerely,

CDM McCombs II

Charles D. McCombs II
Superintendent, Design
and Development

CDM/rmd

DESIGN & DEVELOPMENT DIVISION, 2920 Duncan Road
Wilmington, DE 19808 571-7760

The Delran Sewerage Authority

MUNICIPAL BUILDING, CHESTER AVENUE
Burlington County
DELRAN, NEW JERSEY 08075

April 12, 1978

Department of the Army
Philadelphia District, Corps of Engineers
Philadelphia, Pennsylvania 19106

Attn: Joel T. Callahan

File: H2410001

Dear Sir:

In reference to your letter dated February 23, 1978 on Delaware River Dredging disposal study, please be advised the Delran Sewerage Authority is very interested in this study.

As stated in a letter dated March 15, 1978 from Delran Township, the Authority would like to be kept posted on any activities to be taken in this area.

Very truly yours,

George Barton

George Barton
Secretary

GB/mrp

RUTGERS
THE STATE UNIVERSITY
OF NEW JERSEY

COOK COLLEGE • MOSQUITO RESEARCH AND CONTROL
P.O. BOX 231 • NEW BRUNSWICK • NEW JERSEY 08903 • U.S.A. • 201/932-9341

April 18, 1978

Lt. Col. Joel T. Callahan
Corps of Engineers
Custom House-2 D & Chestnut Sts.
Philadelphia, PA 19106

Dear Lt. Col. Callahan:

I have received your correspondence concerning the Delaware River Dredging Disposal Study by way of several of our county mosquito control commissions. The problems of dredge spoil disposal has interested mosquito control personnel since the early 1900's, since these areas can breed large numbers of mosquitoes.

On June 14, 1977 the mosquito control community of New Jersey met with the New Jersey Dredge Disposal Technical Committee to discuss some of our problems with dredge spoil sites. Many of the problems that concern us are similar to those facing other mosquito control agencies around the nation. The U. S. Army Engineers Waterways Experiment Station has instituted a study to determine what are some of these problems and how can they be solved? New Jersey has had input in the preparation of the report through correspondence, and visits to exchange ideas in methods to control mosquitoes on dredge spoil disposal sites. A preliminary study was made in 1977 in New Jersey to determine the effect of dredge spoil sites on mosquito production (see enclosed prepublication by Shisler). The report includes a summary of individual dredge spoil sites in the counties and their mosquito breeding history. Some of the sites were not created by dredging but the problems are the same with interrupted drainage patterns that create mosquito breeding sites, and these sites then have to be treated by the county mosquito control commissions.

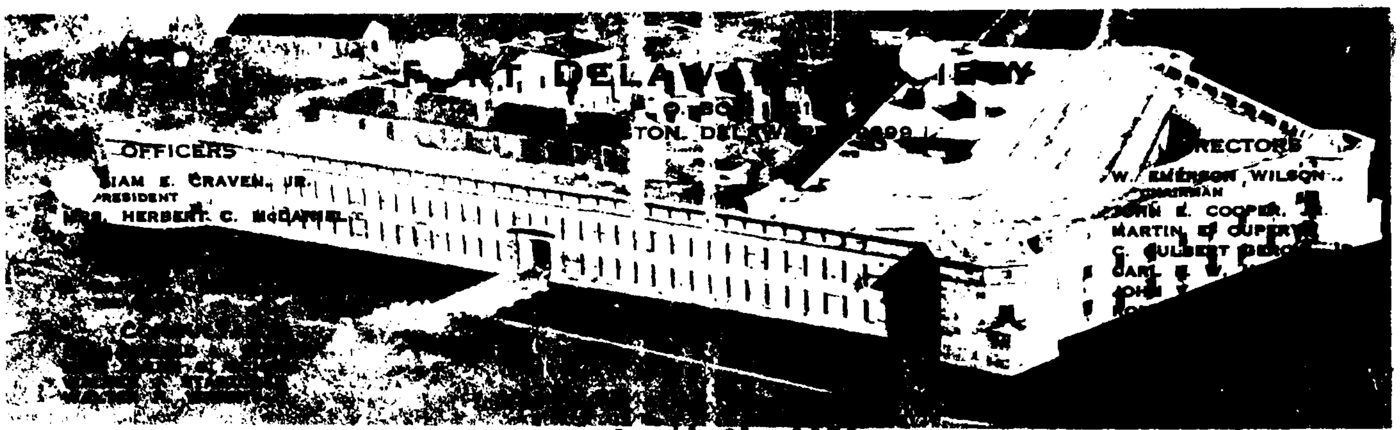
State and county mosquito control personnel would like to assist you in your study and be informed as to major developments in order to possibly alleviate any problems before they occur.

If you have any questions, please feel free to contact me or any of the county mosquito commissions in which a dredge spoil site may occur.

Sincerely yours,

Joseph K. Shisler, Ph.D.
Assistant Research Professor

cc: Dr. K. W. Bruder
County Superintendents
Mr. Roy Denmark



April 21, 1978

Department of the Army
Philadelphia District, Corps of Engineers
Custom House - 2D & Chestnut Sts.
Philadelphia, PA 19106

Attn.: Lt. Col. Joel T. Calahan, Acting District Director

Ref: NAPEN-R 23 February 1978

Dear Sir:

Thank you for advising us about the Delaware River Dredging Disposal Study.

The Fort Delaware Society's major objective in the past 28 years has been the preservation of Fort Delaware as a historic monument. We cooperate actively with the State of Delaware, Division of Parks & Recreation, as an advisory group, by law, on both maintenance and operation of the Fort.

Fort Delaware is the focal point of Fort Delaware State Park located on Pea Patch Island off Delaware City. The entire island is included in the park. Major visitor attractions on Pea Patch Island are the old fort which is on the National Register of Historic Places, and a heronry on the northern fringe of the island. This heronry is believed to be the only nesting grounds of its type in this region of the country.

The state of Delaware will soon complete various improvements on Pea Patch Island and at Delaware City which are designed to improve visitor access to Fort Delaware and increase tourism in the area. These improvements, costing over $1.5 million, include renovation of moat walls and control structure, cleaning of moat, construction of new pier, walkway, well and rest room facilities on the island, and bulkheading, lock restoration, pier improvements and construction of parking facilities, park maintenance center, paved plazas and walkways within the Delaware City complex. Improved boat service between Delaware City and Pea Patch Island is also being initiated this year.

In December 1971, a preliminary draft "Environmental Statement - Branch Channel, Vicinity of Delaware City, Delaware", was issued by the Philadelphia district. This preliminary draft proposed that a dredge disposal site be established at the northern end of Pea Patch Island. At a public hearing held March 9, 1972, the Fort Delaware Society expressed opposition to this proposed disposal site and gave historic and environmental reasons for its objection. The idea of a disposal site on Pea Patch Island was abandoned after the then governor of Delaware, Russell W. Peterson, indicated that the State of Delaware opposed the idea.

The historical and environmental reasons for not using Pea Patch Island as a disposal site still exist, and, in fact, are more valid today than in 1972. This has resulted from the natural growth of the heronry on the northern edge of the island and the physical improvements noted above which are expected to increase annual visitations to Pea Patch Island.

We therefore assume that the Corps of Engineers has no plans to propose using Pea Patch Island as a disposal site.

Pea Patch Island appears to be increasing in size in a westerly direction through natural silting action while, at the same time, suffering erosion on the easterly side.

As part of the physical improvements noted above, two sunken barges on the west side of the island are being removed. This is expected to diminish the silting action at the docking end of the island pier. It is possible, however, that dredging operations may be necessary at the island pier some time in the future.

We also assume that your office is aware of the dredging needs at the Delaware City dock. This area, once largely unusable due to silting, is now much improved over its former state.

Erosion is occurring on the easterly side of Pea Patch Island due to storm created breaks in the protective rip-rap. The walls of the Civil War era dock in the vicinity of the channel light have also been damaged by storms. Plans to repair the Civil War era dock have been set aside temporarily by the state of Delaware due to a lack of sufficient funds. The main channel is close to the island at this point such that the wakes of passing ships have rendered the Civil War dock unusable by small boats and have increased erosion on the island.

With regard to the above matters (need for erosion control, rip-rap and dock wall repairs and possible future dredging needs), it is recommended that your office consult with the State of Delaware, Department of Natural Resources, Division of Parks & Recreation, John E. Wilson, III, Director, at Box 1401, Dover, Delaware, 19901.

The Fort Delaware Society is very much interested in any plans the Corps of Engineers might formulate which affect the Delaware City - Pea Patch Island area. We are appreciative of your concern in advising us of the present study and we ask that you continue to keep us fully informed.

If we can be of further assistance, or if you desire more information, please advise.

Very truly yours,

William E. Craven

William E. Craven
President
Fort Delaware Society

CC: J. E. Wilson, III, Director of Parks & Recreation
Mrs. E. D. Krapf, Secretary, Fort Delaware Society

WEC:ssb

COUNCIL OF CIVIC ORGANIZATIONS
of
BRANDYWINE HUNDRED

312 Marsh Road
Wilmington, Del.19809
April 23, 1978

Lt.Col. Joel T. Callahan
Acting District Engineer
Phila.Dist.,Corps of Engineers
Custom House-2D & Chestnut Sts.
Philadelphia, Pa. 19106

Dear Sir, DISPOSAL AREA - "FOX POINT PARK"

I have your letter of Feb. 23rd addressed to Mr. Beck, former President of our Council and wish to endorse the disposal area referred to in Mr. C.D. McCombs' letter of 4/6/78. He is Supt. of Design & Development for N.C. County Dept. of Parks & Recreation.

In addition, I wish to give you more details and indicate there would be a PUBLIC BENEFIT if new ground is created by fill at the Park area.

"FOX POINT PARK" is County owned and is on the Delaware shore between Edgemoor and Claymont. It was acquired with State and B.O.R. funds and is in the process of development. It consists of three main sections:

	Feet	Miles	
NORTH of STONEY RUN	11,120	2.1	Proposed DISPOSAL AREA
South of " "	7,288	1.4	Filled & being developed
Entrance Corridor	1,500	.3	Between Artic & duPont Plants
Total Length	19,908	3.8	

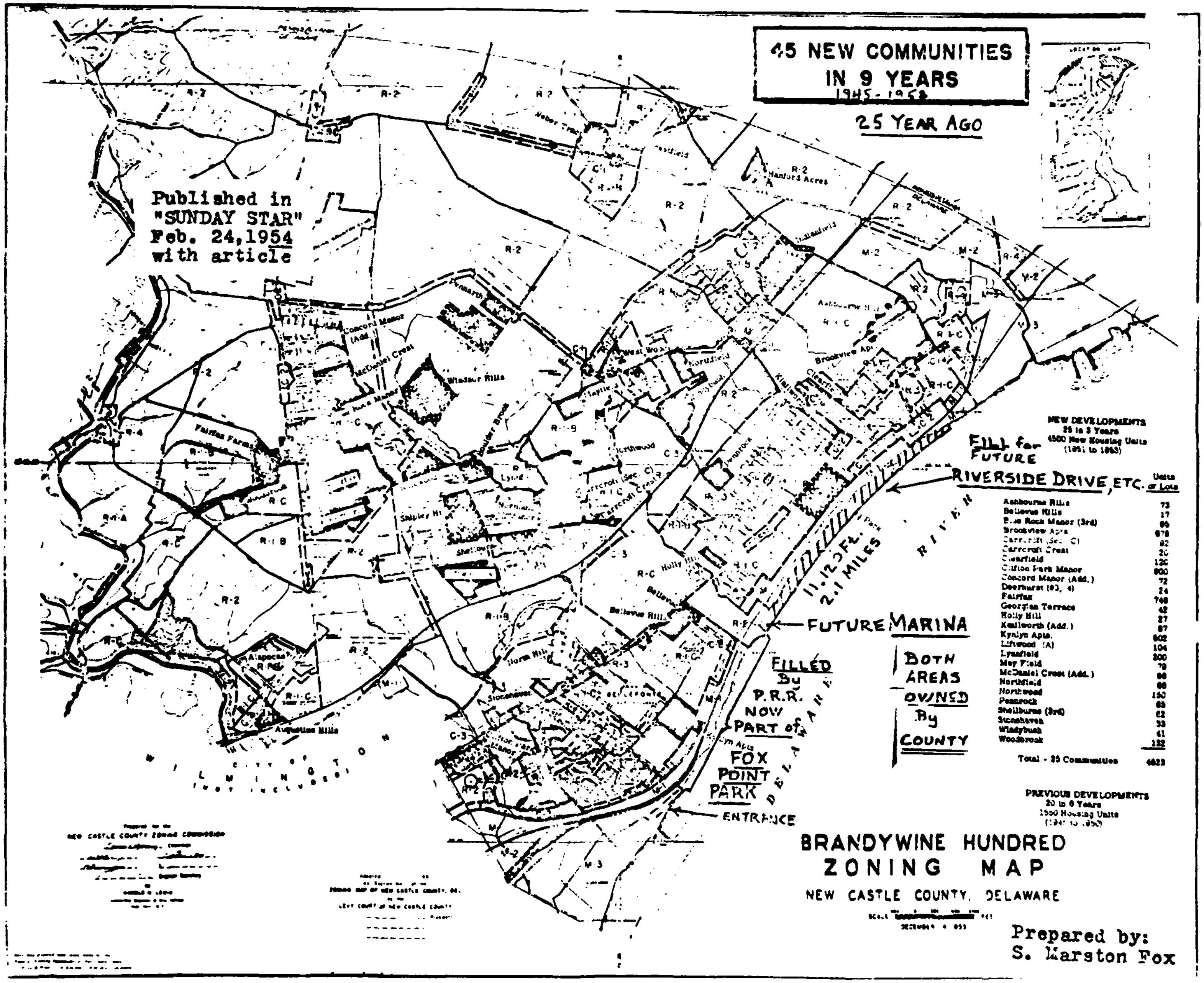
This whole riverfront has been on record for years as a disposal area. When the Penn.R.R.Co. filled the area South of Stoney Run, there were major public objections because their intent was to create heavy industry immediately adjacent to a densely populated residential area. The attached map is marked to show the above three areas of the park. The base map was published 25 years ago to show the residential nature of the area. I prepared it to show the intense residential growth that was taking place at that time. Since then, growth has continued and we are running out of open space.

There has been strong public support for a park along this riverfront as evidenced by the fact that the State passed a bill to buy the entire 3.5 miles and deed it to the County for a park. Development North of Stoney Run is contingent upon obtaining fill, and dredgings from the ship channel has long been considered as our only hope.

People in this area enjoy the river. I have seen many cars parked along the Printz Blvd. inland of the tracks, and a riverside drive and park has been a long sought delight. There is no place north of New Castle where people can legally enjoy the river.

The center of the unfilled portion North of Stoney Creek is near the junction of the Bellevue & Marcus Hook Ranges, opposite the mouth of Oldmans Creek. I frequently have seen your dredge off-leading dredged material on the Jersey side near this point, but I do not know of any public benefit that will result. Thus, the suggested area warrants close consideration.

Respectfully,
S. Marston Fox
S. Marston Fox, Chairman
Bellevue & Fox Point Parks Committee


45 NEW COMMUNITIES
IN 9 YEARS
1945-1953
25 YEAR AGO
Published in
"SUNDAY STAR"
Feb. 24,1954
with article
NEW DEVELOPMENTS
25 in 3 Years
4500 New Housing Units
(1951 to 1953)
FILL for
FUTURE
RIVERSIDE DRIVE, ETC.
RIVER
11,125 Ft.
2.1 MILES
FUTURE MARINA
BOTH
AREAS
OWNED
By
COUNTY
FILLED
By
P.R.R.
NOW
PART of
FOX
POINT
PARK
ENTRANCE
DELAWARE
Total - 25 Communities
PREVIOUS DEVELOPMENTS
20 in 6 Years
1550 Housing Units
BRANDYWINE HUNDRED
ZONING MAP
NEW CASTLE COUNTY, DELAWARE
Prepared by:
S. Marston Fox

DELMARVA ADVISORY COUNCIL
SUITE 700, ONE PLAZA EAST P.O. BOX 711
SALISBURY, MARYLAND 21801
PHONE 301/742-9271

April 25, 1978

Joel T. Callahan, Lieutenant Colonel
Acting District Engineer
Philadelphia District, Corps of Engineers
Custom House, 2nd & Chestnut Streets
Philadelphia, Pennsylvania 49106

Re: NAPEN - R

Dear Colonel Callahan:

Our Committee was very interested to learn that your District had initiated a Delaware River Dredging Disposal Study, which would include the tributaries as well as the tidal portion of Delaware Bay. An overall study such as you described in your 23 February, 1978, letter is a much needed aspect of channel and harbor maintenance in that area.

However, we were distressed to learn that little attention was planned for fishing ports, particularly those located along the Delaware coastline where shoaling can and has caused extensive problems. We believe that these ports are integral to the local economies of the area and deserve some attention to their problems.

If we can be of any assistance in your consideration of this aspect of your planning, please feel free to contact us. Thank you for your consideration.

Sincerely,

John Lewis

John Lewis
Chairman, Seafood Advisory Committee

B-234

858-2457

BOROUGH OF OAKLYN

BOROUGH HALL

OAKLYN, NEW JERSEY 08107

April 26, 1978

Department of the Army
Philadelphia District Corps of Engineers
Customs House - 2D & Chestnut Streets
Philadelphia, Pa. 19106

Attention: Joel T. Callahan
Lt. Col. Corps of Engineers
Activity District Manager

Re: NAPEN-R Borough of Oaklyn, N.J.

Dear Sir:

Your letter addressed to the Borough Clerk of Oaklyn has been referred to me for an appropriate reply.

I believe it would be appropriate for the Borough of Oaklyn to call to your attention to the project undertaken by Camden County and the Goff Avenue inlet feeding into Newton Lake.

Presently, we are experiencing undue delay and frustration because of the State of New Jersey Department of Environmental Protection requirements for a reparian conveyance for all properties adjoining the inlet on both sides.

Any additional information on this project on County level should be addressed to Mr. Thomas Sellers, Camden County Mosquito Extermination Commission, Egg Harbor Road, Lindenwold, New Jersey.

For Mayor and Council,

J. Thomas Platt

J. Thomas Platt
Borough Administrator

JTP:wmo

dcedc delaware county
economic development committee
602 East Baltimore Pike Media, Pa. 19063 215-565-3680

May 16, 1978

Joel T. Callahan
Lieutenant Colonel, Corps of Engineers
Acting District Engineer
Department of the Army
Philadelphia District Corps of Engineers
Customs House - 2D & Chestnut Streets
Philadelphia, PA 19106

Dear Lieutenant Callahan:

Reference is made to your form letter of February 23rd to the Delaware County Surveyor, c/o Delaware County Courthouse. Your letter was referred to my by members of the Delaware County Council.

It is our understanding that you are initiating a Delaware River dredging disposal study. When the study is completed, I would very much appreciate it if you would forward a copy to me at the following address:

Manuel S. Whitman
Director of Economic Development
Delaware County Economic Development Center
602 E. Baltimore Pike
Media, PA 19063

Thank you very much for your cooperation.

Very truly yours,

Manuel S. Whitman
Director of Economic Development

MSW/nrd

Enclosure

cc: Richard Erdmann
Chris van de Velde
Hon. Dennis Rochford

APPENDIX C

NATURAL RESOURCES

AD-A094 799 ARMY ENGINEER DISTRICT PHILADELPHIA PA F/G 13/2
DELAWARE RIVER DREDGING DISPOSAL STUDY, STAGE 1 RECONNAISSANCE --ETC(U)
JUN 79
UNCLASSIFIED DAEN/NAP-10072/RR-79/06 NL

5 OF 12
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A094799

APPENDIX C

NATURAL RESOURCES

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SECTION C-1

DELAWARE RIVER
DREDGING DISPOSAL STUDY

OVERVIEW INVENTORY
& POTENTIAL IMPACT DISCUSSION

February, 1979

Prepared for:

Department of the Army
Philadelphia District Corps of Engineers
Custom House 2nd & Chestnut Sts.
Philadelphia, Pennsylvania 19106

Betz • Converse • Murdoch • Inc. BCM
Consulting Engineers and Planners

DELAWARE RIVER DREDGING DISPOSAL STUDY

OVERVIEW INVENTORY AND POTENTIAL IMPACT DISCUSSION

FOR

U. S. ARMY CORPS OF ENGINEERS

PHILADELPHIA, PENNSYLVANIA

Work Order Numb 8

Contract Number DACW 61-78-D-0018

February 7, 1979
(Revised March 5, 1979)

Prepared by: Elizabeth L. Loeb
Elizabeth L. Loeb
Biologist/Planner

Approved by: Thomas G. May
Thomas G. May. P.E.
Assistant Vice President

Betz•Converse•Murdoch•Inc.
One Plymouth Meeting Mall
Plymouth Meeting, Pennsylvania 19462

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INTRODUCTION

This report presents an environmental overview of the Delaware Estuary and thirteen adjacent counties in Pennsylvania, New Jersey and Delaware. Features covered are climate, physiography, soils, suface water, groundwater, wetlands, vegetation (other than wetlands), and water and shore-based recreation. A general inventory of these features has been developed, and the potential impacts of dredging and dredge disposal activities are discussed. Projections of recreational needs and surface water quality have been made in those counties for which information was available. For all other features, only existing conditions were discussed.

Several of the environmental features, such as climate, physiography, and groundwater, lend themselves to a regional discussion. The remaining features--soils, surface water, wetlands, vegetation, and recreation--are inventoried by county.

CLIMATE

The entire study area lies within one broad climatic zone, which is considered subtropical, with hot summers, mild winters, and regular rainfall. Summer weather patterns are influenced by maritime tropical air masses, where high pressure systems dominate and remain stable for several days at a time. Weather systems in the winter are generally more intense because of rapidly moving fronts and continental polar air masses.

Flooding in areas of poor drainage is common during many thunderstorms. Severe flooding occasionally occurs when heavy rain coincides with snow-melt, especially when the ground is still too frozen to absorb such significant runoff. Temporary droughts, or periods of subnormal runoff, are not uncommon in the study area. The last protracted drought occurred during the years 1960-1968.

Table 1 summarizes the general climatic characteristics of the region. Figure 1 shows a wind rose for the Philadelphia area. Although extreme temperatures, precipitation and wind conditions will potentially impact dredging and dredged material disposal activities, these events are largely unpredictable. A range of only six degrees in average annual temperature over the entire study area is indicated by Table 1. The range of average annual precipitation is eight inches per year. Other climatic conditions are generally constant over the study area. Due to the relative uniformity of climatic conditions in the thirteen-county study area, climate is not considered a significant factor in the selection of disposal sites.

TABLE 1

CLIMATIC CHARACTERISTICS

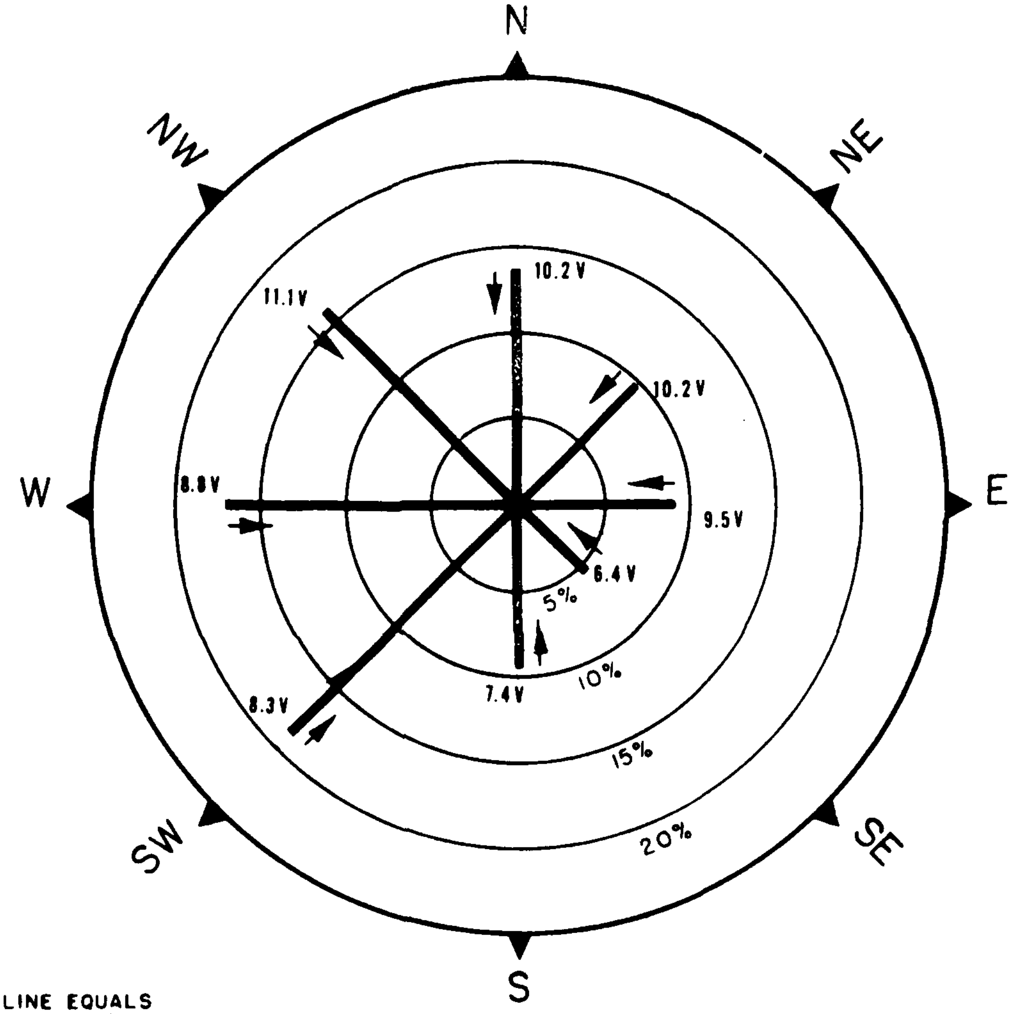
TEMPERATURE	
Average annual temperature:	50°F, Upper Bucks Co. 54°F, Burlington Co. 56°F, Sussex Co.
Temperature in 90°F range:	20-30 days/year
Temperature below freezing:	100 days/year (approx.)
Frost-free growing season:*	188 days, State of Delaware 191 days, Cumberland Co. 210 days, Philadelphia Co.
PRECIPITATION	
Average annual precipitation:	40 inches/year, Delaware Bay 42 inches/year, Philadelphia Co. 46 inches/year, Gloucester Co. 48 inches/year, Sussex Co.
Average annual snowfall:	16 inches/year, Sussex Co. 23 inches/year, Salem Co.
WIND	
Prevailing wind direction:	Northwest, west, and southwest
Average hourly speed:	9 miles/hour (approx.)
HUMIDITY	
Average humidity:	1 A.M.: 80%, Salem Co. 1 P.M.: 55%, Salem Co.
HURRICANE SEASON:	June - November

* Although Philadelphia is farther north than Delaware or Cumberland Counties, the growing season may be longer due to the fact that temperatures around large cities are generally warmer than the surrounding countryside.

Source: U.S. Army Corps of Engineers, Delaware Bay-Chesapeake Bay Waterway in Delaware, Maryland, and Virginia (Delmarva Waterway) Draft EIS; Chester-Betz Engineers, COWAMP/208 Preliminary Draft Chapter IV: Environmental Characteristics of the Study Area, 1975; Salem County Planning Board, A Plan for Comprehensive Development, 1970.

FIGURE 1

SURFACE WIND ROSE
PHILADELPHIA AREA PATTERN



NOTE
LENGTH OF LINE EQUALS PERCENTAGE FREQUENCY

V= AVERAGE VELOCITY IN MILES PER HOUR

AVERAGE ANNUAL
WIND VELOCITY AND DIRECTION

SOURCE: U.S. DEPARTMENT OF COMMERCE,
WEATHER BUREAU

COUNTY PLANNING BOARD
COUNTY OF CAMDEN, N.J

References

Camden County Planning Board. "Water Resources in the Camden Urban Region," Camden, New Jersey, 1961.

Chester-Betz Engineers. "COWAMP/208 Preliminary Draft Chapter IV: Environmental Characteristics of the Study Area," Philadelphia, Pennsylvania, 1975.

Parker, G. "Water Resources of the Delaware River Basin," Geological Survey Professional Paper 381, U.S. Geological Survey, Washington, D.C., 1964.

Salem County Planning Board. "A Plan for Comprehensive Development," Salem, New Jersey, 1970.

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PHYSIOGRAPHY

Introduction

Physiographic provinces are geographic areas characterized by similar topography resulting from the action of climatic factors on geologically related structures. Portions of three physiographic provinces have been identified in the study area. The Reading Prong Section of the New England Province covers a small portion of Bucks County. The second province is the Piedmont Province, which is divided into the Triassic Lowland Section and the Piedmont Upland Section. The Coastal Plain is the third physiographic province. The locations of the provinces are shown in Figure 2. The underlying geology of each province and section will be presented first, followed by a discussion of the characteristic topography of each section.

Geology

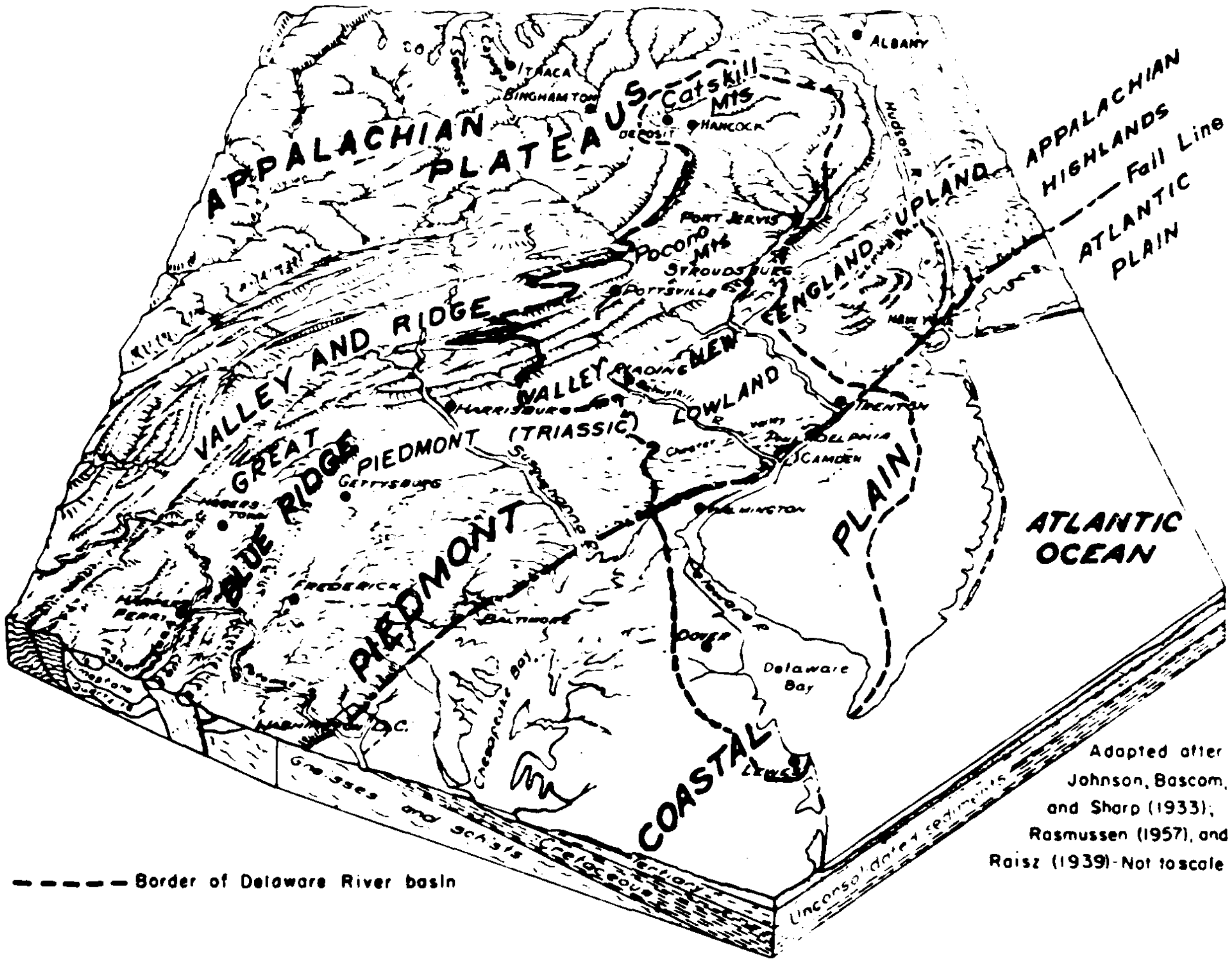
The physiographic provinces and sections in the study area vary greatly in their geologic structure. The geology of the area is important as the primary determinant of surface topography and groundwater availability. Groundwater occurrence and use will be discussed in a later section.

New England Province - Reading Prong Section: The Reading Prong Section is restricted in the study area to 20 square miles in extreme northern Bucks County. It represents a large faulted mass of overturned folded rock composed of crystalline gneisses and quartzite of Precambrian and Cambrian age.

Piedmont Province - Triassic Lowland Section: The Triassic Lowland covers three-fourths of Bucks County between the Reading Prong and a line between Langhorne and Morrisville, and extends into northern Mercer County. It consists of interbedded sedimentary rocks deposited in a low-lying downfaulted area of the Piedmont. These sandstones, shales and conglomerates dip gently to the northwest, and are thought to be erosional products of the ancient Appalachian Mountains. Some igneous intrusions of diabase, which is much more resistant to weathering than sedimentary rock, outcrop east of Doylestown.

Piedmont Province - Piedmont Upland Section: Most of Philadelphia and Delaware counties lie in the Piedmont Upland, which also extends north into lower Bucks County and south into New Castle County above Wilmington. The Piedmont Upland is a very old structure, and is extremely faulted and folded. It is also a geologically complex mass

FIGURE 2: PHYSIOGRAPHIC PROVINCES



Source: Parker, G., 1964, Water Resources of the Delaware River Basin, U.S.G.S Professional Paper 381.

consisting of igneous and metamorphic crystalline rock formations of Precambrian age. Metamorphosed Paleozoic sediments and carbonates also occur in the Piedmont Upland.

Coastal Plain Province: The Coastal Plain is a wedge of sedimentary deposits overlying a seaward-sloping foundation of crystalline rock. Because of the inclination of basement rock, the Coastal Plain sediments range in depth from a few feet where they abut the Piedmont Upland, to 7500 feet thick under Cape Henlopen, Cape May, and the mouth of Delaware Bay. These sediments lie in an undisturbed depositional sequence and are composed of unconsolidated and semi-consolidated sands, gravels and clays. Some are marine sediments deposited when these areas were covered by the sea, and some are of upland origin, including glacial till washed down from the north by the Delaware River. Most of the study area in New Jersey and Delaware lies in the Coastal Plain Province.

Topography

The weathering forces of wind, precipitation and stream flow act upon local geologic formations to produce land surface features, called topography. Since climatic factors are relatively uniform over the study area, each physiographic province and section is weathered into a characteristic topography. Knowledge of local topography is important to this study because it determines the pattern and quantity of runoff and stream flow. Topographic features are also important when selecting potential dredged material disposal sites.

New England Province - Reading Prong Section: The Reading Prong portion of Bucks County is characterized by high crystalline hills and ridges. Streams tend to flow along fault lines, and have moderately or steeply sloping banks. Elevations range between 500-1000 feet.

Piedmont Province - Triassic Lowland Section: The Triassic Lowlands are a region of low rolling hills interrupted by ridges representing diabase intrusions. The rocks are less resistant than those of the Piedmont Upland, so elevations are generally lower, ranging from 150-500 feet, while the ridge elevations are between 400-700 feet.

Piedmont Province - Piedmont Upland Section: The Piedmont Upland is characterized by gently rolling hills, dissected by mature stream valleys. Some outcrops of resistant rock occur, and steep slopes are common along the upper reaches of the major creeks. Elevations in the study area range between 150 feet at the Fall Line to 450 feet in the north and west. The Fall Line is the linear boundary between the Piedmont and the Coastal Plain. Rapids or waterfalls, such as the Trenton Falls on the Delaware and the falls of the Schuylkill, occur where

streams drop from the resistant rocks of the Piedmont to the Coastal Plain. Many cities, including Wilmington, Chester, Philadelphia, and Trenton, were located on the Fall Line because it represented the limit of navigable waters and was a prime location for water-powered mills. The Fall Line also marks the end of tidal influence on larger streams.

Coastal Plain Province: The Coastal Plain in New Jersey is topographically divided into the Inner Coastal Plain, where all streams drain to the Delaware River, and the Outer Coastal Plain, where all streams drain to the Atlantic Ocean. The upland area separating the two sections is only about 200 feet in elevation, and runs through northern Mercer County, the middle of Burlington and Camden counties, eastern Gloucester County and down the center of the Cape May County peninsula. All of Salem and Cumberland counties lie in the Inner Coastal Plain. The Inner Coastal Plain is older than the Outer, and is more highly dissected by streams. It is a level to gently undulating surface rising to rolling hills along the drainage divide.

The Coastal Plain of Delaware is also divided into two separate sections which drain to the Delaware and Chesapeake bays. The divide runs through western New Castle and Kent counties and northern Sussex County to Cape Henlopen. Elevations range between sea level and 125 feet, averaging about 40 feet across the state. All counties experience local drainage problems due to the extremely flat topography and soil characteristics.

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Burlington County Planning Board. "Natural Features in Burlington County," Mt. Holly, New Jersey, 1973.

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Delaware Valley Regional Planning Commission. "Environmental Overview Statement for the Delaware Valley Region," Philadelphia, Pennsylvania, 1975.

Kent County Regional Planning Commission. "Comprehensive Plan - Kent County, Delaware," Dover, Delaware, 1971.

Moody and Associates. "COWAMP/208 Preliminary Draft Appendix IV-A - Geology and Mineral Resources," prepared for Chester-Betz Engineers, Philadelphia, Pennsylvania, 1975.

Salem County Planning Board. "A Plan for Comprehensive Development," Salem, New Jersey, 1970.

U.S. Soil Conservation Service. "The First State Resource Conservation and Development Plan," U.S. Department of Agriculture, Dover, Delaware, 1973.

SOILS

Introduction

Soils are the products of the decomposition and weathering of organic material and inorganic rock. Each soil type is characterized by its chemical composition, structure, texture, permeability, and a variety of other factors. General soil patterns of a geographic area are described by soil associations. Associations are groupings of a few major and several minor soil types usually encountered together in a characteristic pattern, and the name of the most abundant soil type is given first. Table 2 is a list of the dominant soil types in the study area.

Soil characteristics are an important determinant of the suitability of an area for dredged material disposal. Some of the important soil features to examine when choosing disposal sites are slope, drainage, permeability, and depth to bedrock or water table. For example, it is impractical to deposit dredged material on sites that are steeply sloping, and if the soil is extremely permeable, leachate from disposal sites may contaminate groundwater supplies. The erodibility of soil is also important to this study in that hundreds of thousands of cubic yards of sediment are eroded each year from the New Jersey and Delaware shores. Sedimentation, however, will be discussed elsewhere in the report.

The soils of each county in the study area have been evaluated; soils within the coastal region were given special attention.

Soil Associations by County

Bucks County: The riverfront soils below Tullytown are primarily in the Urban Land-Howell association. These soils are either developed or their use is limited by slow permeabilty. Between Riegelsville and Falls Township, the riverfront soils are primarily the nearly flat, gravelly, floodprone soils of the Alton-Pope association. The Alton-Pope soils appear to be the most useful for dredged material disposal in Bucks County, as most other soil types encountered along the Delaware River have unfavorable water table and permeability characteristics.

From southeast to northwest, the major inland soil associations of Bucks County are Urban Land-Chester, Lansdale-Lawrenceville, Abbottstown-Reading-Reaville, Abbottstown-Doylestown-Reaville, and Towhee-Neshaminy-Mount Lucas. These are all upland soils that exhibit a wide spectrum of drainage characteristics. Due to the slope and stoniness of the most northern association, these areas have remained in woodland. The soils

TABLE 2

DOMINANT SOIL TYPES, BY COUNTY

	Bucks	Philadelphia	Delaware	Mercer	Burlington	Camden	Gloucester	Salem	Cumberland	Cape May	New Castle	Kent	Sussex
Abbottstown	X												
Adelphia					X								
Aldino											X		
Alluvial					X	X	X						
Alton	X												
Aura						X	X	X	X				
Atsion									X				
Barclay						X	X						
Beach										X			X
Beltzville			X										
Berryland								X	X				
Birdsboro				X									
Bucks				X									
Butlertown			X										
Chalfont				X									
Chester	X	X	X										
Chillum								X	X				
Chrome			X										
Collington						X	X						
Colt's Neck							X						
Conowingo			X										
Donlonton					X								
Downer						X	X	X	X	X			
Doylestown	X			X									
Dragston				X		X							
Dune													X
Elkton								X			X		
Evesboro				X				X	X				
Fallsington							X	X	X		X	X	X
Fort Mott										X			
Freehold					X	X	X						
Galestown				X	X			X					
Glenelg			X										
Hammonton									X	X			
Holmdel					X	X							
Howell	X					X							
Keansburg					X								
Keyport					X			X			X		
Klej					X				X	X			
Kresson						X							

TABLE 2 (Continued)

	Bucks	Philadelphia	Delaware	Mercer	Burlington	Camden	Gloucester	Salem	Cumberland	Cape May	New Castle	Kent	Sussex
Lakehurst						X							
Lakeland						X							
Lakewood						X			X				
Lansdale	X												
Lawrenceville	X												
Lehigh				X									
Manor			X										
Marlton						X							
Matapeake								X	X		X	X	
Mattapex						X		X	X		X	X	
Mount Lucas	X			X									
Muck						X	X			X			X
Neshaminy	X		X	X									
Nixonton					X	X							
Othello								X			X	X	
Penn				X									
Pocomoke							X		X	X			X
Pope	X												
Quakertown				X									
Reading	X												
Readington				X									
Reaville	X												
Rumford													X
Sassafras			X	X	X		X	X	X	X	X	X	X
Shrewsbury					X								
Swamp													X
Tidal Marsh				X				X	X	X	X	X	X
Tioga				X									
Towhee	X												
Urban Land	X					X				X			
Westphalia						X	X						
Woodstown					X	X	X	X		X	X		X

Source: Betz-Converse-Murdoch-Inc.

of the Triassic Lowland portion of the county, where the middle three associations are dominant, are best used for agriculture and livestock production. Urban development has precluded the use of Urban Land-Chester soils for any single large land use besides development.

Philadelphia County: Only two soil associations are found in Philadelphia. These are the Urban Land-Howell and Urban Land-Chester associations. Most of the soils are developed, but where they are not, their usefulness is limited because of their slow permeability and steepness.

Delaware County: Much of the Delaware County riverfront is intensively developed. Where it is not, the predominant soil association is Beltsville-Sassafras-Butlertown. These are deep silty or sandy soils formed on Coastal Plain sediments. They are gently sloping and highly suitable for farming, but most are fallow and planned for development. The gently sloping, well-drained character of these soils makes them potentially suitable for disposal of dredged material.

Most of the eastern two-thirds of the county's inland soils are in the Glenelg-Manor-Chester association. These are well-drained soils suitable for farming and livestock production. The northwest part of the county has Neshaminy-Glenelg soils. These lands are best used for hay crops and pasture. Neshaminy-Chrome-Conowingo soils occupy a strip of land in the center of the county between Wawa and Newtown Square. They are not very fertile, and much of the open land is idle.

Mercer County: Most of the Mercer County shoreline below the Trenton Falls is either developed or freshwater marsh. Freshwater marsh soils are unsuitable for dredged material disposal for a number of reasons, including potential destruction of a particularly valuable ecosystem and aquifer recharge functions. Where non-marsh soils along the shore remain undeveloped, they belong to the Galestown-Evesboro association. These soils are of a sandy or silty texture, but some areas underlain by clays are swampy due to poor drainage. Extensive soil evaluations will be necessary before choosing potential disposal sites in Mercer County. Above Trenton, the shoreline soils are Birdsboro-Tioga. These are found on level stream terraces, and are deep and well-drained. Because precipitation permeates rapidly through this soil, there is a danger of contaminating groundwater from land disposal of dredged material.

The predominant soil association of the Coastal Plain in Mercer County is Sassafras-Dragston. These soils are suitable for agricultural and urban uses. The soils of the Piedmont include Bucks-Penn-Reading, Quakertown-Chalfont-Doylestown, and Neshaminy-Mount Lucas-Lehigh. Shallowness, stoniness, and slow permeability limit the ability of these soils to treat septic effluent. These factors have, in the past, restricted residential and industrial development of the Piedmont.

Burlington County: All three of the soil associations located adjacent to the Delaware River in Burlington County have severe limitations for sanitary landfills. These associations are Galestown-Klej, Freehold-Holmdel-Adelphia, and Keyport-Donlonton. If the soils are unsuitable for use as sanitary landfills, it is possible that disposal of dredged material on these soils would degrade the environment as well. However, soil associations are very generalized, and studies of specific sites may indicate the presence of some soils suitable for dredged material disposal.

There are 13 soil associations in Burlington County. In general, the soils of the Inner Coastal Plain are finely textured, and subsoils are dominantly fine sandy loam, sandy clay loam, clay loam and sandy clay. Most of these soils are naturally fertile and are cleared for farming. The Outer Coastal Plain soils consist of a very sandy surface layer and sandy subsoils. Subsoil layers of clay occur in the Pine Barrens. The soils in such areas are characterized by low available water capacity and low fertility. Only specialized agriculture is possible in the Pine Barrens, whereas the rest of the Outer Coastal Plain is suitable for general crops.

Camden County: The Downer-Woodstown-Dragston soils which border the Delaware River in Camden County are almost totally developed for urban use. These soils are sandy and gravelly, and support small farms where the land is still open.

Soils reaching two to five miles inland are in the Howell-Urban Land association. These soils have a high runoff potential, and most areas are developed. The rest of the soils in the county are variable in their qualities, and some which remain undeveloped are highly fertile. The Freehold-Holmdel-Collington association, a band of soils from two to five miles wide, lies southeast of the Howell-Urban Land soils. Although they are fertile soils, much of the farmland is being converted to urban uses. A narrow band of the Marlton-Kresson association is found east of the latter association. Marlton and Kresson soils are fertile, but farming is hampered by clay content and a high water table. Westphalia-Nixonton-Barclay soils, found in a wavy band further east, are moderately fertile but very erodible, limiting their developability.

The southeastern half of the county is a collage of the Aura-Downer, Downer-Woodstown-Dragston, and Muck-Alluvial associations. The latter soil types are located along streams. Most soils in the southeast are well-drained and suitable for farming, though not highly fertile.

Gloucester County: The dominant soil association of the non-marsh shoreline in Gloucester County is Downer-Woodstown-Sassafras-Klej. These soils are found on sandy flats along the Delaware River and are

well-drained, with the water table more than 5 feet below the surface. Areas which are not being held for industrial development have been cleared for vegetable crops. Site studies would show if the permeability rate of these soils is too high for use as dredged material disposal sites. A Muck-Alluvial soil association is common along the floodplains of streams up to two miles inland from the Delaware.

The major soil associations of the inland northern half of the county are Freehold-Colt's Neck-Collington and Westphalia-Nixonton-Barclay. Both are nearly level or gently sloping, and well-drained. Soils along streams are clayey and wet, or steep. In the southern portion of the county, Aura-Sassafras-Downer soils occupy areas between streams. They are gravelly and well-drained, and are best used for farming or woodlands. Muck-Alluvial-Fallsington-Pocomoke soils occur in broad river valleys and are prone to flooding. One-third of Gloucester County's soils, primarily in the west, are classified as prime agricultural land.

Salem County: Along the Delaware River between Penn's Grove and a point south of Salem City, the Mattapex-Othello-Woodstown association is most commonly found. These soils are nearly level and silty, with poor to moderate drainage qualities. Nearly all of this area has been cleared for cropland. Because of drainage restrictions, these soils are not highly suitable as disposal sites for dredged material. South of Salem, the tidal marsh association supports wetlands that are generally unsuitable for filling.

Seven other soil associations are distributed through Salem County. The Sassafras-Woodstown-Fallsington association covers the largest amount of land, 18% of the county. These soils lie in a strip between Upper Penn's Neck Township and Elmer. They are sandy and nearly level, with good to poor drainage. These same characteristics hold for the Aura-Sassafras-Downer soils in Pittsgrove Township, the Sassafras-Evesboro-Downer association in Alloway and Quinton townships, and the Galestown-Sassafras-Berryland association along the north shore area of Oldman's Township. Both the Mattapex-Matapeake and Chillum-Othello-Mattapex associations, located in the center of the county and Upper Pittsgrove Township, respectively, are silty soils. Each is usually level to gently sloping, though the Mattapex-Matapeake soils are occasionally found on steeper slopes. A very small amount of Keyport-Elkton soils, which are poorly drained due to a high clay content, are found in Alloway and Quinton townships. Most of the above associations have been cleared for farming with the exception of Tidal Marsh and Sassafras-Evesboro-Downer. The latter association remains primarily in native hardwood forest vegetation. Although 45% of Salem County soils are classified as prime agricultural soils, only 36% are available for farming because of urbanization.

Cumberland County: Most of the soils of Cumberland County are well-suited to a variety of land uses, including agriculture. The exceptions are the Tidal Marsh and Muck-Atsion-Berryland associations. The Tidal Marsh covers 14.8% of the county, including all of the shoreline and areas adjacent to the Cohansey and Maurice rivers. Muck-Atsion-Berryland soils are found in small pockets on the inland side of the wetlands. These soils are very poorly drained and support Pine Barrens forests. Most of the area immediately inland of the marsh is the Hammonton-Fallsington-Pocomoke association. This association occupies the terraces adjacent to wetlands which are very poor to moderately well-drained. Although some areas are farmed, the soils are most appropriate for woodland cover due to drainage constraints. Aura-Downer-Sassafras soils, located in the county's inland area, cover more than half of the total county. These are well-drained loamy, sandy and gravelly soils located in upland areas, and are moderately productive farmlands with few limitations for urban use. The Matapeake-Chillum-Mattapex association is found in the western section of the county along the Salem County boundary. These soils occupy the highest elevations in Cumberland County and are well-suited for agriculture. The inland floodplain of the Maurice River is primarily the Evesboro-Klej-Lakewood association. The low fertility and available moisture of these soils makes them most suitable for forest cover.

Cape May County: Five soil associations are found in Cape May County. The Delaware Bay shoreline south of the town of Villas and the entire Atlantic coast is the Coastal Beach-Urban association, which consists of bare beach, dune vegetation and filled tidal marshes. The Tidal Marsh association occupies most of the Delaware Bay shoreline, the Dennis Creek floodplain and the Atlantic coast behind the barrier islands. The Downer-Sassafras-Fort Mott association occupies 28% of the county along the Garden State Parkway and in scattered pockets. These are areas of relatively high elevation and are the most productive farmlands in Cape May County, when irrigated. The remainder of the inland area is either the Hammonton-Woodstown-Klej or Pocomoke-Muck association. The latter soils are very poorly drained and support Pine Barrens vegetation. The Hammonton-Woodstown-Klej areas also have drainage limitations, though they are less severe. The fluctuating water table limits the suitability of these soils for development.

New Castle County: North of New Castle, Delaware, the soils of the Piedmont and the shoreline are disturbed by urbanization and difficult to identify. This area includes the Matapeake, Sassafras, Othello, Fallsington, Aldino, Keyport and Mattapex soils. South of New Castle, the waterfront is characterized by tidal marshes. Two isolated parts of New Castle County near Odessa and Taylor's Bridge contain Keyport-Elkton soils. These sites are level to gently sloping, but have severe drainage and erosion problems.

The soils of the central inland portions of the county are primarily in the Matapeake-Sassafras association. Matapeake soils are sandy, medium textured and well-drained. They are adaptable to agricultural and urban uses. Sassafras soils are also well-drained and sandy, but have some development constraints. The soils in southern New Castle County are Fallsington-Sassafras-Woodstown. All are permeable, sandy clay loams over a sandy subsoil, and are nearly level. Fallsington soils are less suitable than the others for agriculture and development due to a high water table.

Kent County: The nearly continuous Tidal Marsh association along the Delaware Bay is bounded on the inland side by Othello-Matapeake-Mattapex soils. Although the latter two soil types of this association have good drainage, permeability, and stability characteristics, they are of limited development value when they are found with the poorly drained, slightly permeable Othello soils. Where Matapeake and Mattapex soils occur without Othello soils, these sites may be suitable for disposal of dredged material.

A band of Sassafras-Fallsington soils runs north and south through the center of Kent County. These are highly productive agricultural areas, whose suitability for farming is limited locally only by the percentage of poorly-drained Fallsington soils present. Soils with moderate or severe development limitation are scattered throughout the county, though most of the productive farmland is also suitable for development.

Sussex County: In general, the soils of Sussex County, Delaware are very wet. The Tidal Marsh-Beach-Dune association covers the Delaware Bay and Atlantic Ocean shorelines of the county. The soils behind the tidal marsh along the bay, and extending two to six miles inland, are the Sassfras-Fallsington association. These are areas of good to poor drainage and moderate permeability. Sassafras soils are the best in the county for farming. Most of this area is cultivated except where drainage is poor and woodlands remain. The Evesboro-Rumford association covers 47% of the county land area. These excessively drained soils are suitable for non-farming uses and farming, if irrigated. Fallsington-Pocomoke-Woodstown soils are also common in the interior of Sussex County, predominantly in upland, headwaters areas. Hardwood forests are generally found in conjunction with this association, though the soils are suitable for farming if artificially drained. The southeast corner of the county is typically in the Pocomoke-Fallsington-Evesboro association. These soils are either very poorly drained or excessively drained, and impose severe constraints on non-farm uses. The soils are only suitable for farming if artificial drainage or irrigation is provided. Fallsington-Sassafras-Woodstown soils occupy the northwest and southwest portions of the county, and most areas remain wooded due to

naturally wet conditions. A small area along the southern boundary line, which supports a cypress and cedar swamp, is in the Muck-Pocomoke-Swamp association. This area is naturally suited only to use as a woodland and wildlife habitat.

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SURFACE WATER

Introduction

The surface water resources of the study area include the large Delaware Estuary as well as small tributaries, man-made impoundments and canals, natural lakes, and bays off the Atlantic Ocean. These water resources are important for such diverse uses as public water supply, waste assimilation, recreation, industrial cooling, wildlife habitat, and navigation.

Many of the region's water bodies have become severely degraded in the past 35 years, ruling out several of the above uses. In response to national and state legislation, recent pollution control activities have resulted in improved quality of most of the streams in the study area; it is expected that quality will continue to improve significantly in the coming years.

The following pages contain a discussion of the Delaware Estuary and the water resources of the adjacent counties which are under tidal influence. Where data were available, the discussion includes some analysis of existing water quality and the potential for improvement. Following the inventory of water resources, Tables 6 and 7 classify and list the significant point source dischargers in the study area.

Delaware Estuary

The Delaware Estuary is tidal for 133.4 miles, or as far north as the falls at Trenton. The mean annual flow is greater than 12,000 cubic feet per second (cfs) at Trenton, but during extremely dry periods, such as the drought of the 1960s, the flow is much less. The minimum recorded flow was 1,180 cfs in 1963. Salinity in the estuary is controlled by the flow, and on the average, the salinity of the water is too high to permit its use for drinking water (after reasonable treatment) south of Camden. Chloride levels greater than 250 mg/l exceed safe drinking water standards. However, the water supply of the City of Philadelphia has been threatened by salinity levels as high as 95 mg/l in the river when the flow is extremely low.

The water quality in the estuary is also linked to the volume of flow. The Delaware is unable to assimilate as large a pollution load when flow is reduced as it can at normal volume. Even under normal flow conditions, the river is highly polluted between Philadelphia and Wilmington. Dissolved oxygen and fecal coliform standards are repeatedly violated, precluding use of the river for human contact and healthy aquatic communities. Above Philadelphia, pollution levels are moderate. Dissolved

oxygen standards are violated in summer and fall, when flow is lowest. Although there is occasional fecal coliform contamination above Philadelphia, the water is used for human contact recreation and water supply. Water quality improves below Wilmington, with the water in the open bay ranging from moderate to high quality. Dissolved oxygen levels fall below normal occasionally. Coliform levels are acceptable in the Delaware Bay.

Heavy metals contamination is a significant pollution problem in the Delaware Estuary. High average values of mercury, manganese and lead have been measured, and high maximum values of cadmium, chromium, copper, iron, nickel and zinc are occasionally recorded.

Typical summer values of dissolved oxygen, pH, hardness and dissolved solids are listed in Table 3. Table 4 shows the present and future water uses of five segments of the Delaware Estuary. The water quality standards in the estuary are less stringent than they are for the rivers in the region.

Surface Water by County

Bucks County: Water quality data are available for two sub-basins of the Delaware Valley in Bucks County which are delineated in Figure 3. Tohickon Creek is the major tributary to the Delaware River in Upper Bucks County. Although pH, dissolved oxygen and fecal coliform are the three parameters for which criteria have been violated, high levels of biochemical oxygen demand (BOD), nutrients and ammonia have been measured and are attributed to several sewage treatment plant discharges. Neshaminy Creek and several smaller streams in its drainage basin are tributary to the Delaware below Bristol, Pennsylvania. The water quality of the main stem of the Neshaminy is generally fair to poor. Dissolved oxgyen, total solids, phosphate and pH standards are violated. High levels of the heavy metals zinc and iron are also a problem. Municipal and industrial discharges are listed as the probable primary causes of pollution in the Neshaminy.

Sand and gravel mining operations have created Manor Lake and Van Sciver Lake in Falls Township. These lakes have a combined acreage of 1080 acres, and their levels are artificially maintained by pumping from the Delaware River. Their quality, therefore, is linked to that of the Delaware. Presently, nutrient and fecal coliform contamination is a problem in these lakes, caused in part by malfunctioning on-lot sewage disposal systems.

TABLE 3

TYPICAL WATER QUALITY ANALYSES FOR SUMMER STREAM FLOW CONDITIONS ON THE DELAWARE RIVER

Location (River Mile)	Dissolved Oxygen (mg/l)	pH	Hardness (mg/l)	Total Dissolved Solids (mg/l)
Riegelsville, NJ (175)	7.5	7.0	64	140
Trenton, NJ (133)	8.7	7.9	70	115
Burlington-Bristol Bridge (118)	5.0	6.8	70	185
Torresdale (110)	5.3	---	---	---
Benjamin Franklin Bridge (100)	1.7*	6.7	100	140
Chester (82)	1.2*	6.5	207	208
Delaware Memorial Bridge (69)	3.1*	6.5	420	2,000
Reedy Island (55)	5.4	6.7	1,700	3,000

* Values do not meet water quality standards

Source: DRBC, Eleventh Water Resources Program, July 1974

Philadelphia County: The major tributaries to the Delaware River within Philadelphia are Poquessing Creek, Pennypack Creek, Frankford Creek and the Schuylkill River. All basins (except Frankford) are shown in Figure 3. The overall water quality of Poquessing Creek is satisfactory, although periodically high BOD and ammonia values are recorded downstream. The Pennypack is badly polluted by municipal discharges along its entire length. Although dissolved oxygen is the only standard violated, high levels of BOD, suspended solids, ammonia, nitrates, phosphates and fecal coliform are common. Trout stocking of this stream was halted in 1969 due to its polluted condition and it is no longer used for public water supply. The tidal reach of Frankford Creek shows low levels of dissolved oxgen, high nutrient values, and an increase in coliform bacteria.

TABLE 4: *Recognized present and future water uses according to the Delaware River Basin Commission and State of Delaware Water Quality Standards*

Purpose of water use	*Zone 2* Trenton-Morrisville Bridge (RM 133.4)[1] to Torresdale (RM 108.4)		*Zone 3* Torresdale (RM 108.4) to Big Timber Creek (RM 95.0)		*Zone 4* Big Timber Creek (RM 95.0) to Del.-Pa. state line (RM 78.8)		*Zone 5* Del.-Pa. state line (RM 78.8) to Liston Point (RM 48.2)		*Zone 6* Liston Point (RM 48.2) to Atlantic Ocean (RM 0.0)	
	Present	Future	Present	Future	Present	Future	Present	Future	Present	Future
Water supply (after reasonable treatment):										
Agricultural	x	x	x	x	...	...	...	...	...	...
Industrial	x	x	x	x	x	x	x	x	x	x
Public water	x	x	x	x	...	...	...	...	...	...
Wildlife	x	x	?	x	?	x	?	x	x	x
Maintenance of resident fish and aquatic life.	x	x	?	x	?	x	x	x	x	x
Propagation of resident fish and acquatic life.	x	x	...	...	...	...	x[2]	x	x	x
Passage of anadromous fish	...	x	...	x	...	x	...	x	...	x
Recreation[3]	x	x	x	x	?	x	x	x	x	x
Navigation	x	x	x	x	x	x	x	x	x	x
Maintenance and propagation of shellfish.	...	...	...	...	...	...	...	...	x	x

x Denotes recognized use.

? Denotes marginal or questionable use.

[1]RM denotes river miles from the mouth of the bay. The midpoint between Cape May and Cape Henlopen is considered as river mile 0.00. The tidal barrier at Trenton is located 133.4 river miles from the mouth.

[2]From RM 70.0 to 48.2

[3]Recreation is defined in the Water Quality Standards as follows: The streams in Delaware are generally small, shallow, and murky. Water contact recreation (swimming, water skiing, *etc.*) is therefore, quite limited. However, other recreation, such as picnicking, hiking, fishing, *etc.*, is feasible. In order to ensure safe usage, all municipal, domestic, and industrial waste discharges contributing coliforms to the stream will be controlled to the extent required.

Source: College of Marine Studies, University of Delaware, 1972, The Coastal Zone of Delaware.

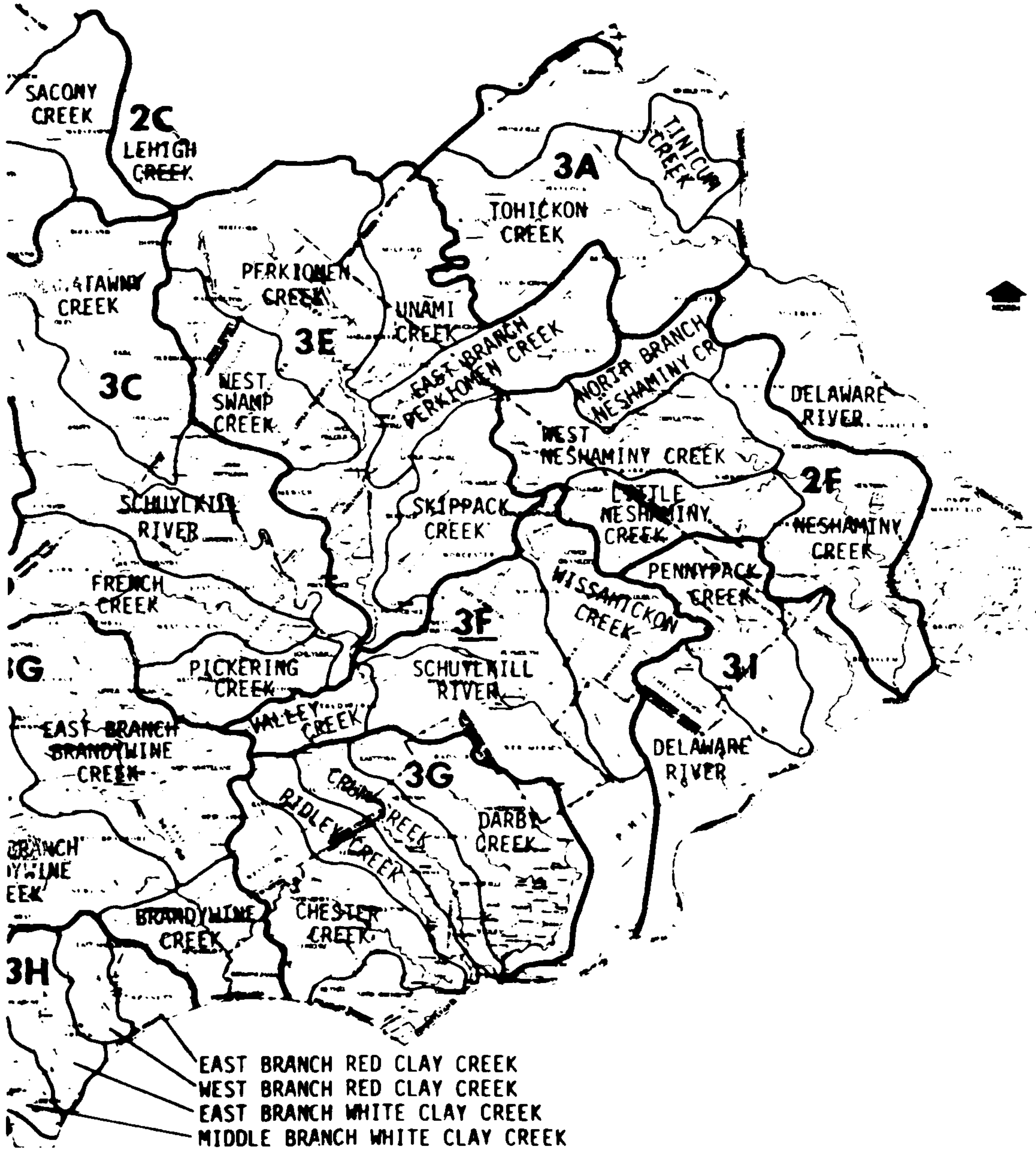

FIGURE 3

PENNSYLVANIA DRAINAGE BASINS

Prepared For
PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL RESOURCES
By
CHESTER-BETZ ENGINEERS
COWAMP STUDY AREA NO. 1
February 1975

The Schuylkill River is tidal to the Fairmount Dam. While better than the Delaware Estuary, the Schuylkill's water quality is still considered poor. Besides the pollution generated by municipal point sources, industries in the lower Schuylkill basin discharge oil, heavy metals, suspended solids, toxic materials and heated wastes into the river. Urban runoff is also an important nonpoint pollution source. Dissolved oxygen, pH, and copper standards are violated in the Schuylkill, and zinc and BOD levels are also high.

Delaware County: Five major streams flow southeasterly through Delaware County to the Delaware River. Their drainage basins are shown in Figure 3. From east to west, they are Cobbs Creek, Darby Creek, Crum Creek, Ridley Creek and Chester Creek. All five streams are tidal in the Coastal Plain portion of the county. The creeks are characterized by well-defined valleys, steep slopes, and floodplains of varying widths. Two impoundments are located on Crum Creek, and two lagoons were created in the tidal segment of Darby Creek by dredging for fill for an interstate highway.

Water quality is generally good upstream, but lower reaches are degraded by sewage treatment plant discharges. Locally, high nitrate and phosphate problems are traced to point source discharges, on-lot sewage disposal, and runoff from agricultural land.

Mercer County: A ridge running northwest to southeast bisects the county into two major drainage basins. Moore Creek, Fiddler's Creek, Jacobs Creek, Shipetaukin Creek, Assunpink Creek, Miry Run and Crosswicks Creek all drain to the Delaware River. Stony Brook, Big Bear Brook, Rocky Brook, and the Millstone River are part of the Raritan drainage system.

In general, widespread violations of total phosphorus and fecal coliform standards have been observed in Mercer County streams. Point sources of pollution seem to have overwhelming effects on stream quality. All impoundments are potentially eutrophic due to extreme nutrient enrichment.

Burlington County: Eight streams are tributary to the Delaware River in Burlington County. Crosswicks Creek forms part of the northern boundary of the county. Severe total phosphorus and fecal coliform problems are characteristic of the tidal segment, and are attributed to urban runoff, landfills, and one sewage treatment plant. Black's Creek, Craft's Creek and Assiscunk Creek are smaller than Crosswicks, and their drainage basins lie entirely within Burlington County. Three point sources in the tidal portion of Black's Creek violate fecal coliform and phosphorus standards. These same standards are violated in Craft's Creek and Assiscunk Creek as well, though nonpoint sources play more of

a role in the degradation of these streams than they do in the Black's Creek watershed. Assiscunk Creek also exhibits low dissolved oxygen levels and violations of the pH standard.

Rancocas Creek is the largest stream in Burlington County, and its 346-square-mile drainage basin lies almost entirely within the county boundaries. Moderate dissolved oxygen depletion is aggravated by the tidal influx of water from the Delaware River. Although several sewage treatment plants influence water quality in the tidal segment, nonpoint sources are believed to be the major cause of total phosphorus and fecal coliform violations. Swede's Run and Pompeston Creek are two smaller streams for which water quality data are unavailable.

Pennsauken Creek forms the southwest boundary of Burlington County, but 75% of its watershed area is in the county. It is tidal along the main stem and a few miles of its north and south branches. One landfill on the main stem and several treatment plants on both branches have caused major problems with total phosphorus, ammonia nitrogen, and dissolved oxygen. The influence of the treatment plants is too great to reliably assess the impacts of most nonpoint sources.

Camden County: Pennsauken Creek and Big Timber Creek form the northern and southern boundaries of Camden County. The quality of these streams has been discussed in the Burlington and Gloucester County sections. The two other streams in Camden County which flow to the Delaware River are the Cooper River and Newton Creek. The lower three miles of the Cooper River below Cooper River Lake dam are tidal, and highly urbanized. Four industrial treatment plants cause violations of phosphorus, ammonia nitrogen and fecal coliform standards. Depressed dissolved oxygen levels reflect the influence of the Delaware River on the tidal reach. The same three water quality criteria that are violated in the Cooper River are also exceeded in Newton Creek. These problems are attributed to six sewage treatment plants in the Newton basin.

Gloucester County: Nine streams flow directly into the Delaware River in Gloucester County. These streams are Oldman's Creek, Raccoon Creek, Mantua Creek, Big Timber Creek, Little Timber Creek, Repaupo Creek, Nehonsey Brook, Clonmell Creek, and Woodbury Creek. The first four are the largest and are tidal for the last four or five miles of their length. The smaller creeks are tidal only very close to the Delaware River. Other small streams in the county are tributary to the Maurice and Great Egg Harbor rivers, and exhibit no tidal fluctuation. Several lakes fed by groundwater occur in the southern portion of the county.

Fecal coliform and phosphate pollution are severe problems in Oldman's Creek, Raccoon Creek, Mantua Creek and Big Timber Creek. Dissolved oxygen depletion and pH are potential water quality problems in these streams. Degraded conditions have been traced to point sources, landfills, and, possibly, runoff from agricultural land.

Salem County: The four major streams in Salem County are all tributary to the Delaware River. These streams are Oldman's Creek, Alloway Creek, Salem River and Maurice River. The mouth of the Maurice River is in Cumberland County. In the interior, upland portion of their drainage basins, the streams are narrow, but they widen into meandering streams with broad floodplains as they fall into the nearly flat portions of the Coastal Plain.

Water quality data are available for Oldman's Creek, Salem River and Alloway Creek. Oldman's Creek exhibits possible dissolved oxygen, fecal coliform and nutrient problems, though fecal coliform counts improve near the Delaware River. The Salem River below Woodstown has high fecal coliform and low dissolved oxygen values. Water quality projections indicate that "application of effluent limited technology will be insufficient to meet water quality standards"* in the Salem River. Alloway Creek shows elevated fecal coliform and ammonia levels, but a dissolved oxygen problem is improving.

Potential water quality problem areas in Salem County include low-flow streams such as Oldman's and Alloway Creeks, the headwaters of the Salem River near Woodstown, and Salem River in the vicinity of Mannington Creek.

Cumberland County: There are two major rivers in Cumberland County--the Cohansey, which flows south to southwest 27 miles, and the Maurice River, which originates in Gloucester County but flows 33 miles through Cumberland County. Both flow to the Delaware Bay, have a very low gradient, and a meandering channel and abundant marshlands in the tidal reaches. Numerous smaller streams are also tributary to the Delaware Bay. They are characteristically short and wide, with little variation in flow due to constant recharge from abundant groundwater reserves.

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* NJDEP, Phase I Water Quality Management Basin Plan - Delaware River Tributaries, Zones 5 and 6, Draft, 1976.

Water quality analyses indicate that the Maurice and Cohansey rivers are similar. The tidal reaches of both streams are degraded, and exhibit low dissolved oxygen levels and fecal coliform and nutrient contamination. Computer simulation of future water quality indicates that "application of effluent limited technology will be insufficient to meet water quality standards" in the Cohansey and the Maurice rivers.* Water quality data are unavailable for the smaller tributary streams.

Cape May County: The largest tributary to the Delaware Bay in Cape May County is Dennis Creek, which discharges approximately one mile south of the Cumberland-Cape May boundary. Dennis Creek and its tributaries drain an area of 130.8 square miles in Cape May County. Water quality data for this stream were not available.

The upland portion of the Cape May Peninsula is only three miles wide or less. Drainage occurs primarily through the tidal marshes surrounding the peninsula and very short streams segments penetrating the peninsula.

New Castle County: Naaman's Creek and Shellpot Creek discharge to the Delaware River just below the Pennsylvania border, and both drain the Piedmont Upland portion of New Castle County. Fecal coliform criteria are violated on both streams, though this contamination will be alleviated by sewer construction. Low dissolved oxygen values may reflect the influence of the Delaware River water in the short tidal reaches. The Christina River is tidal for the lower 12 miles, to the eastern end of Smalley's Pond. The quality of the Christina has been degraded by nonpoint pollution sources and tidal exchange with the Delaware River. The water quality has, and will continue to, improve following sewer renovation and improvement in the quality of the Delaware River. The Appoquinimink River and Blackbird Creek are very similar to each other. They drain the Coastal Plain Province, and each is tidal for the lower eight miles. Although they flow through undeveloped areas, fecal coliform standards are exceeded in both streams. Nonpoint pollution from wildlife and domestic animals is believed to be the source of the contamination. Stream flow data for Blackbird Creek and the Christina River are shown in Table 5.

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* NJDEP, Phase I Water Quality Management Basin Plan - Delaware River Tributaries, Zones 5 and 6, Draft, 1976.

TABLE 5: *Stream-flow data for the Delaware River estuary, Piedmont Plateau, and Atlantic Coastal Plain streams in Delaware draining to the Delaware Estuary and the Atlantic Coast*

Type of stream	Location	Drainage area	Years of record in 1968	Average discharge[1]	Maximum discharge	Minimum discharge	Average discharge per square mile
		square miles		*cubic feet per second*	*cubic feet per second*	*cubic feet per second*	*cubic feet per sec*
Delaware River estuary							
Delaware River	Trenton, N J	6,780	56	11,930	329,000	1,220	1 76
Piedmont Plateau streams[2]							
Shellpot Creek	Wilmington	7 46	22	9 07	4 650	0 10	1 12
White Clay Creek	Above Newark	66 7	13	72 1	4,540	4 6	1 08
White Clay Creek	Near Newark	87 8	28	104	6,640	4 7	1 18
Red Clay Creek	Near Wooddale	47 0	25	60 3	6 000	4 5	1 29
Little Mill Creek	Elsmere	6 70	5	8 99	3,960	0 10	1 34
Brandywine Creek	Chadds Ford Pa	287	48	375	17 200	42	1 31
Brandywine Creek	Wilmington	314	22	436	17,800	56	1 39
Coastal Plain streams							
Christina River[2]	Cooches Bridge	20 5	25	25 3	2,620	0 20	1 23
Blackbird Creek[3]	Blackbird	3 85	12	4 25	510	0	1 10
St Jones River[2]	Dover	31 9	10	30 0	1,900	0	0 91
Murderkill River[2]	Near Felton	13 6	10	16 8	2 090	0 80	1 24
Beaverdam Branch[3]	Houston	2 83	10	3 47	176	0 20	1 22
Sowbridge Branch[2]	Near Milton	7 08	12	9 76	134	1 3	1 38
Stockley Branch	Stockley	5 24	25	6 95	132	0 13	1 33

[1] One cubic foot per second equals 646,323 gallons per day.
[2] Record good
[3] Record fair

Source Sundstrom, R W , and R D Varrin, Water supply and use in the drainage basins of the Delaware River system and Atlantic coastal drainage basins in Delaware, 1971, page 19 Water Resources Center, University of Delaware, Newark, Delaware

NOTE Figures from U S Geological Survey, Department of Interior, Washington, D C

Kent County: Eight streams in Kent County are tidal tributaries to the Delaware Estuary. The Smyrna River forms part of the boundary between New Castle and Kent counties, and is fresh above Flemings Landing. Below this point, the water is brackish, but the overall quality is good along the entire length. The Smyrna River is tidal for 11.3 miles. The Leipsic River drains Massey's Mill Pond and Garrison's Lake, and is part of the Bombay Hook National Wildlife Refuge. At 275 feet wide, it is the widest tributary to the estuary in Delaware. The Leipsic is a muddy river, but overall water quality is good and improving. The 26-mile segment above the mouth has been selected for further study for possible designation as a Wild and Scenic River. Simon's Creek, Mahon River and Little River are all of good quality, and brackish. The quality of the St. Jones River has historically been poor, though it has improved since the Kent County regional sewage treatment plant has been in operation. Recovery is expected to continue. The St. Jones River is tidal to river mile 10.4, and salinity ranges from slightly brackish to very salty near Bowers Beach. The Murderkill River drains five fresh ponds, but becomes brackish near the bay. It is tidal for the lower 10.7 miles, and water quality is generally good. Stream flow data for the St. Jones and Murderkill rivers are given in Table 5. The Mispillion River, which forms part of the boun dary between Kent and Sussex counties, drains nine fresh ponds. It is tidal to river mile 11.3, at the eastern end of Silver Lake. Water quality is very good now, since the discharge from the Milford sewage treatment plant has ceased.

Sussex County: Besides the Mispillion River, the Broadkill River is the only major tidal tributary to the Delaware Bay in Sussex County. It drains three inland ponds, and enters the bay at Roosevelt Inlet. Water quality is poor in the sluggish upstream segment due to several point source discharges, but tidal flushing below Milton causes the quality to improve slightly. Overall quality remains poor, but is expected to improve by 1980. Love Creek, Herring Creek and Guinea Creek are all tributaries to Rehoboth Bay behind Rehoboth Beach. Water quality in Rehoboth Bay is degraded in the northeast section near Dewey Beach and the Lewes-Rehoboth Canal. The bay is connected at its southern end to Indian River Bay. The artificially maintained Indian River Inlet links both bays to the Atlantic Ocean. Major tributaries to Indian River Bay are Indian River, Pepper Creek and White Creek. All three are fresh, though the salinity of the bay ranges from brackish to salty at the inlet. In 1969, the Delaware State Planning Office recorded a decrease in species diversity, recent fish kills, low levels of pesticides, and increasing sedimentation rates in both bays. Further evidence of water quality deterioration is the fact that prior to World War II, 100% of Rehoboth and Indian River bays' area was open for shellfishing. Presently, only 84% of Rehoboth Bay and 78% of Indian River Bay are approved for shellfishing. By 1980, wasteloads are projected to decrease 87% from the 1975 levels, and wastewater flow will be halved. Water quality can be expected to improve in the future.

Inventory of Point Source Discharges

The following tables summarize inventories from the areawide waste treatment management plans. Table 6 classifies the discharges as municipal, non-municipal or industrial, and Table 7 lists all point sources discharging 3 million gallons per day (MGD) or more.

TABLE 6

NUMBER OF POINT SOURCE DISCHARGERS

County	Municipal	Non-Municipal	Industrial
Bucks	17	25	43
Philadelphia	3	3	35
Delaware	11	21	36
Mercer	11	6	37
Burlington	29	26	32
Camden	41	6	27
Gloucester	6	3	34
Salem	5	2	13
Cumberland	2	1	21
Cape May	1	2	1
New Castle	5	15	45
Kent	3	7	15
Sussex	---	---	---
TOTAL	134	117	339

Sources: 1. New Jersey Department of Environmental Protection, Phase I Water Quality Management Basin Plan - Delaware River Tributaries, Zones 5 and 6, Draft, 1976

2. New Castle County Areawide Waste Treatment Management Program, 1976

3. DVRPC, 208 Water Quality Mangement Plan, Mercer County 1977

4. DVRPC, 208 Water Quality Management Plan, Burlington, Camden and Gloucester Counties, 1977

5. DVRPC, COWAMP/208 Water Quality Management Plan, Southeastern Pennsylvania 1978

6. BCM, Kent County Wastewater Management Facilities Plan, Vol. I: Report, Plymouth Meeting, Pennsylvania, January 1979

TABLE 7

POINT SOURCES DISCHARGING 3 MGD OR MORE

Facility*	Average Flow MGD	(Year)
Bucks County		
Levittown WPCP (M)	8.70	(1975)
Warminster Township STP (M)	3.80	(1974)
Rohm & Haas Company (I)	11.63	(1977)
U.S. Steel Company (I)	294.05	(1977)
Philadelphia County		
Philadelphia Northeast WPCP (M)	195.00	(1973)
Philadelphia Southeast WPCP (M)	127.00	(1973)
Philadelphia Southwest WPCP (M)	139.00	(1973)
Amstar Corp. Phila. Refinery (I)	22.785	(1977)
Atlantic Refinery (I)	6.00	(1977)
Container Corp. of America	5.184	(1977)
E. I. DuPont deNemours & Co. (I)	4.23	(1977)
Gulf Oil Refinery (I)	41.115	(1977)
National Sugar Refining Co. (I)	17.846	(1977)
Phila. Coke Co. - EAC (I)	4.875	(1977)
Phila. Elec. Richmond Sta. (I)	340.535	(1977)
Phila. Gas Works A - Passyunk (I)	7.374	(1977)
Phila. Gas Works B - Richmond (I)	12.128	(1977)
Publicker Industries (I)	52.35	(1977)
Rohm & Haas Company (I)	8.919	(1977)
Phila. Naval Shipyard (I)	38.921	(1977)
Phila. Elec. Delaware Sta. (I)	264.382	(1977)
Phila. Elec. Schuylkill Sta. (I)	212.020	(1977)
Phila. Elec. Southwark STa. (I)	269.498	(1977)
Delaware County		
Central Delaware Co. Authority STP (M)	10.10	(1974)
Darby Creek Joint STP (M)	15.81	(1973)
Delcora-Chester STP (M)	10.30	(1973)
Muckinapates STP (M)	5.75	(1973)
Phila. Elec. Chester Sta. (I)	37.176	(1977)
Scott Paper Co. (I)	25.04	(1977)
Sun Ship Building Co. (I)	3.325	(1977)
Phila. Elec. Eddystone Sta. (I)	1,442.098	(1977)

TABLE 7 (Continued)

Facility*	Average Flow MGD	(Year)
Delaware County (Continued)		
BP Oil Inc. Refinery (I)	120.720	(1977)
FMC Corporation (I)	5.609	(1977)
Sun Oil Company Refinery (I)	92.35	(1977)
Union Carbide Linde Div. (I)	30.16	(1977)
Westinghouse - Lester Plant (I)	36.023	(1977)
Mercer County		
Ewing - Lawrence Sewer Authority (M)	7.8	
Hamilton MUA (M)	7.9	
City of Trenton (M)	19.32	
Stony Brook Reg. Sewer Authority (M)	4.83	
Burlington County		
Willingboro STP (M)	3.60	
Roebling Steel (I)	7.0	
Camden County		
Cherry Hill Main Plant (M)	3.38	
Pennsauken Sewer Authority (M)	3.75	
Camden Baldwin Run STP (M)	3.60	
Camden City Main Plant (M)	33.00	
Gloucester County		
Gloucester County SA (M)	11.00	
Mobil Oil (I)	18.00	
Salem County		
E. I. DuPont deNemours & Co. - Chambers (I)	159.1	(1977)
Public Service Elec. & Gas (Hope Creek) (I)	4.625	(1977)
Atlantic City Elec. Corp. (I)	311.457	(1977)
Cumberland County		
None		
Cape May County		
None		

TABLE 7 (Continued)

Facility*	Average Flow MGD	(Year)
New Castle County		
Getty Oil Eastern Operations, Inc. (I)	452.0	
ICI United States, Inc. (I)	17.34	
City of Wilmington STP (M)	90.0	
Delmarva Power & Light Co. (I)	1,070.0	
DuPont Co. - Edgemoor Plant (I)	24.76	
Phoenix Steel Corp. (I)	8.0	
Allied Chemical Corp. (I)	37.6	
NVF Co. - Yorklyn (I)	3.25	
Kent County		
Kent County WWTP (M)	6.38	(1975)
Sussex County		
(data unavailable)		

* (M) indicates municipal discharger
(I) indicates industrial discharger; flow may include cooling water

Sources: 1. New Jersey Department of Environmental Protection, Phase I Water Quality Management Basin Plan - Delaware River Tributaries, Zones 5 and 6, Draft, 1976

2. New Castle County Areawide Waste Treatment Management Program, 1976

3. DVRPC, 208 Water Quality Mangement Plan, Mercer County, 1977

4. DVRPC, 208 Water Quality Management Plan, Burlington, Camden and Gloucester Counties, 1977

5. DVRPC, COWAMP/208 Water Quality Management Plan, Southeastern Pennsylvania, 1978

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GROUNDWATER

Introduction

Aquifers are porous geologic formations storing or transmitting groundwater which is available for water supply. Groundwater is the source of the base flow of streams and sustains stream flow during dry periods. Two general types of aquifers are found in the study area. Groundwater in areas underlain by crystalline rock and the consolidated sediments of the Triassic Lowland is contained in fissured or weathered zones of the rock, while Coastal Plain groundwater is found in porous unconsolidated sand and gravel formations. In general, the sediments of the Coastal Plain provide the most productive aquifers, though contamination and salinity intrusion may limit their use in some areas. The formations in the Piedmont Upland and Reading Prong sections are generally poor aquifers. Yields in the Triassic Lowland are variable.

Groundwater in Pennsylvania

Only a small fraction of the total water use in Bucks, Philadelphia and Delaware counties is groundwater. Although locally high yields can be obtained from wells in the Reading Prong and the Piedmont Province, Coastal Plain aquifers are the most reliable. The Raritan, Cape May and Pennsauken formations are the most significant aquifers in Pennsylvania. Four areas of intensive groundwater pumping have been identified in the Coastal Plain. These areas are:

1. South Philadelphia
2. Bristol Borough (Bucks County)
3. Bristol Township - Tullytown Borough (Bucks County)
4. Morrisville Borough (Bucks County)

In all of these areas, groundwater is being withdrawn at rates of 100,000 to 500,000 gallons/day/square mile. In the Bristol Township-Tullytown Borough area, pumping rates are even higher.

Aquifer Recharge: The entire Coastal Plain Province in Pennsylvania is a recharge zone for the Magothy-Raritan aquifer. This aquifer is much more important in New Jersey than in Pennsylvania, though land and water uses in the Pennsylvania portion of the recharge zone potentially impact New Jersey's groundwater supplies. Heavy pumping of the aquifer in Bristol Township south of Tullytown Borough is a problem in Bucks County. Groundwater depletion in this area is causing induced recharge of the aquifer from the Delaware River and Martin's Creek. Under low flow conditions, other heavy pumping problems become apparent. Some areas where groundwater use exceeds recharge during low flow years are

Falls Township south of Morrisville Borough and Bristol Township southwest of Bristol Borough. In these areas, both in Bucks County, induced recharge due to heavy pumping is affecting groundwater quality and surface flow.

Groundwater Quality: Groundwater use in Pennsylvania is limited to a large extent by contamination. In general, groundwater quality is better in Bucks County than in Philadelphia and Delaware counties. Extensive heavy metal contamination of aquifers in urban and industrial areas is common. For example, leachate from landfilling at the Naval Base in Philadelphia has contaminated the Magothy-Raritan aquifer with sulfates, iron and dissolved solids. Industrial and domestic waste disposal practices are causing groundwater contamination in the League Island area and Five Mile Point area in Phladelphia. Locally degraded groundwater supplies in Bucks County have been caused by leachate from iron slag piles and landfills; the problem is particularly severe in the overpumped area of Falls Township. These areas must be considered permanently contaminated, due to the slow movement of groundwater in the aquifers.

Groundwater in New Jersey

One important aquifer is found in the Piedmont Province in Mercer County, New Jersey. The Stockton Formation provides an average yield of 150 gallons per minute (GPM) from its weathered and fractured zone. Reported yields range between 10-1000 GPM. The Brunswick Formation is also fairly productive where fissures are concentrated. The sedimentary deposits of the Coastal Plain, however, are the major source of water supply for all users in the New Jersey counties. Those formations composed of unconsolidated sands and gravels are the most useful aquifers. Layers consisting predominantly of clay are relatively impermeable and often confine aquifers beneath them under pressure. These clay formations are called aquicludes. The aquifers include the Magothy-Raritan, Englishtown, Mount Laurel-Wenonah, Vincentown, and Kirkwood-Cohansey formations. Two of these aquifers, the Magothy-Raritan and Kirkwood-Cohansey formations, yield supplies greater than 500 GPM. The three other aquifers are minor sources, yielding water at rates between 100 and 500 GPM.

The Magothy-Raritan aquifer, composed of medium to coarse sand and clay layers, is considered the most important aquifer in the lower Delaware Valley. For example, it provides 80% of the total water use in Burlington County and 75% in Gloucester County. Rates of up to 1500 GPM are common, and its estimated safe yield is 260,000 gallons per day (GPD)/square mile. This is the amount of water that can safely be withdrawn without exceeding the rate of recharge. This aquifer outcrops in a narrow band along the Delaware River between Penn's Grove in Salem

County and Trenton. The outcrop exends from one to six miles inland, and the aquifer reaches all the way to the Atlantic Ocean at increasing depth.

The contiguous beds of the Kirkwood and Cohansey formations combine to form an aquifer potentially more valuable than the Magothy-Raritan. The Kirkwood Formation is generally an unreliable water source, but it is an important source of recharge for underlying aquifers. Wells in eastern Cumberland County tap the lower Kirkwood aquifer. Yields of up to 800 GPM have been recorded for the Kirkwood-Cohansey aquifer, but it is at present relatively undeveloped and used only for domestic and agricultural supply. The estimated safe yield is 1,000,000 GPD/square mile, greater than that of all other aquifers in New Jersey combined. The outcrop area of 2,350 square miles is also greater than the combined areas of all other aquifers. The western edge of the outcrop is near Artificial Island on the Delaware Bay. The outcrop covers all of Cumberland and Cape May counties, and the southeastern portions of Salem, Gloucester, Camden and Burlington counties. The Cumberland and Cape May portions of the outcrop are partially covered by Pleistocene deposits of the Quaternary period. These deposits are called the Cape May Formation, and they serve as an extension of the Kirkwood-Cohansey aquifer where the deposits are porous, and as an aquiclude where they are composed of clay.

The Englishtown, Mount Laurel-Wenonah and Vincentown formations are minor aquifers outcropping in parallel bands between the Magothy-Raritan and Kirkwood-Cohansey aquifers. They are moderately productive, with reported yields between 100 and 500 GPM, and estimated safe yields of up to 200,000 GPD/square mile. They are used primarily for domestic and agricultural supply.

Aquifer Recharge: The Stockton aquifer is recharged by infiltration over its outcrop area and by vertical leakage from overlying formations. Figure 4 shows the outcrop area of the Magothy-Raritan Formation, and the high-level recharge areas in portions of Mercer and Middlesex counties. Lines of flow of the groundwater in this formation are also shown. Increased pumping in southern New Jersey has begun to change the direction of flow, and induced recharge from the Delaware River is becoming an important factor in the maintenance of the Magothy-Raritan supply. Vertical leakage from overlying formations is an important source of recharge east of the outcrop area.

Because the outcrop area of the Englishtown Formation is so narrow, recharge occurs primarily through infiltration from overlying beds. The same is true for the Mount Laurel-Wenonah and Vincentown formations.

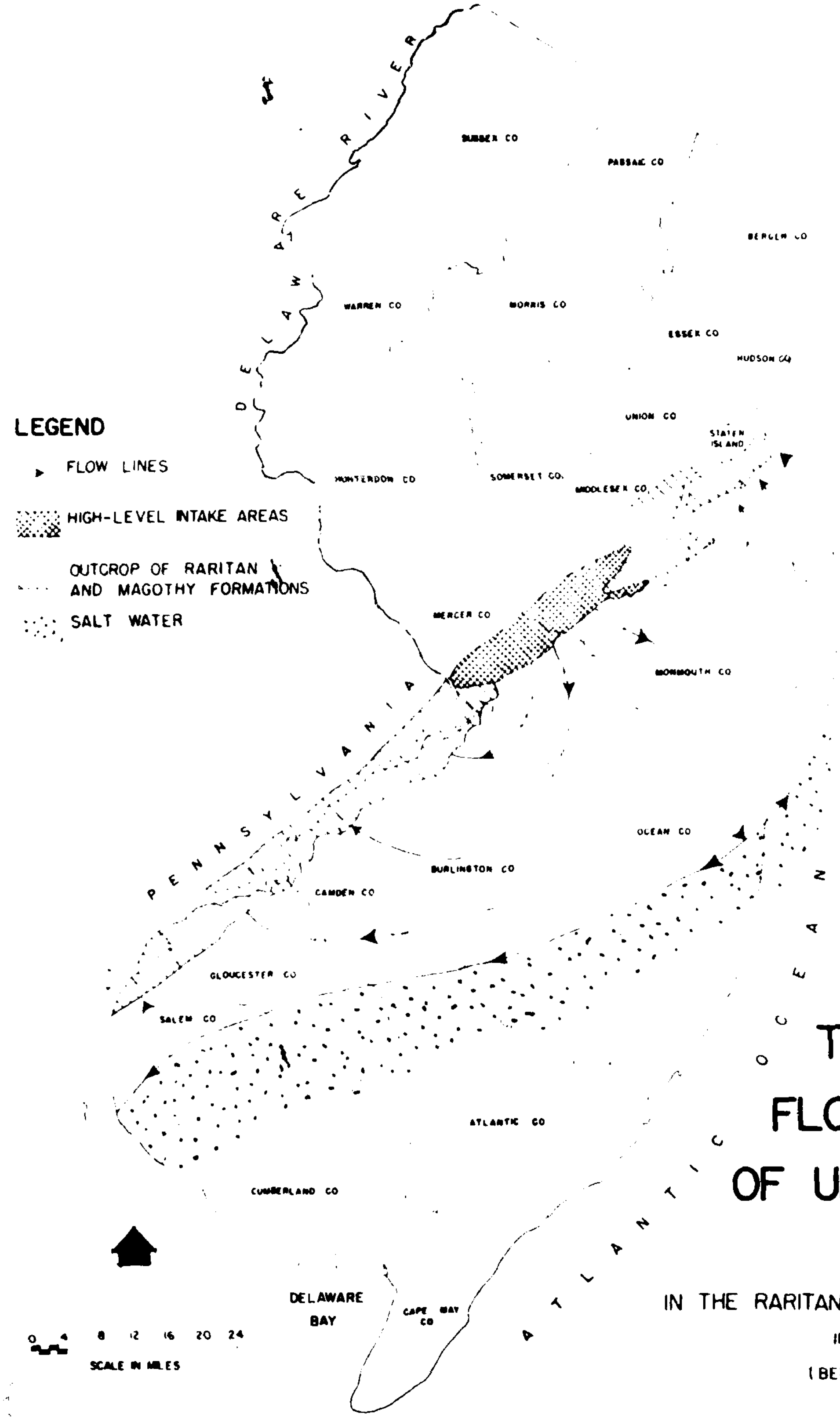


FIGURE 4

THEORETICAL FLOW PATTERN OF UNDERGROUND WATER

IN THE RARITAN & MAGOTHY FORMATIONS

IN THE STATE OF NEW JERSEY

(BEFORE ARTIFICIAL WITHDRAWAL)

SOURCE U.S. GEOLOGICAL SURVEY

BY CAMDEN COUNTY PLANNING BOARD

The Kirkwood-Cohansey aquifer is recharged directly from precipitation over its outcrop area, and the water table is very close to the surface. Recharge is inhibited in some areas by a layer of Quaternary deposits with a high clay content.

Groundwater Quality: The quality of water from the Stockton Formation varies, but is satisfactory for most uses. Moderate hardness and elevated concentrations of dissolved solids are common. Iron and chloride problems are less frequent, though local nitrate concentrations have exceeded health standards.

The interface between saltwater and freshwater in the Magothy-Raritan aquifer is delineated in Figure 4. This line has moved westward as groundwater withdrawal along the urbanized Delaware River waterfront has increased. Overpumping induces saline intrusion not only from the Atlantic Ocean, but also from the Delaware Estuary, and is a potential source of chloride contamination in wells in Salem County. Increased mineralization of the aquifer in Camden County has been traced to an industrial waste dump located over a recharge area near Philadelphia. The aquifer is basically of good quality, however, with isolated hardness, iron, and manganese problems. Quality improves with distance from the outcrop area. The quality of the Magothy-Raritan is closely linked to the quality of the Delaware River, which flows over the outcrop and is hydrologically connected to the aquifer.

The quality of the Englishtown, Mount Laurel-Wenonah and Vincentown aquifers is satisfactory. Isolated iron and hardness problems are common, and may require treatment at the well site.

The high water table of the Kirkwood-Cohansey aquifer makes it extremely vulnerable to degradation. Its quality is determined by local surface conditions, which have limited the use of the aquifer in some areas. Water quality is generally good, though some pH and iron adjustment may be necessary for industrial use. If land uses with the potential to contaminate groundwater are carefully monitored, the Kirkwood-Cohansey will be an extremely valuable water source for southern New Jersey in the future.

Groundwater in Delaware

Due to the geologic similarity between New Jersey and Delaware, groundwater resources can be expected to be abundant in Delaware. In fact, groundwater resources represent 58% of Delaware's total available water supply, although presently only 43% of the water used in the state comes from groundwater sources. Surface water withdrawals are negligible compared to groundwater use in Kent and Sussex counties. However, surface water use in New Castle County far outweighs groundwater pumpage. The population centers of Wilmington and Newark are located in or

near the Piedmont Province, and as explained earlier, groundwater is far less abundant in the crystalline rocks of the Piedmont than in Coastal Plain sediments. Therefore, these cities take most of their water from surface water sources.

Although several of the prominent New Jersey aquifers are found in Delaware as well, they have different names and may be more or less valuable as aquifers in Delaware than they are in New Jersey. For example, the Pleistocene deposits of the Quaternary Period found only in Cape May County and scattered along the Delaware River in New Jersey are far more extensive and important as aquifers in Delaware. As shown in Table 8, the Pleistocene aquifers represent 57% of the developed water supply and 92% of the available supply in Delaware.

Figure 5 shows the extent of the important aquifers in Delaware, and Table 8 lists the available, developed, and remaining supply, by county, for each aquifer. For ease of comparison, the Potomac and Magothy formations in Delaware are of the same origin as New Jersey's Magothy-Raritan aquifer. The Monmouth and Rancocas aquifers in Delaware correlate with the Vincentown and Mount Laurel-Wenonah formations in New Jersey. Delaware's Frederica and Cheswold aquifers are extensions of the Kirkwood Formation in New Jersey, and the Cohansey sands are similar to the Manokin aquifer of Delaware.

In summary, the Pleistocene deposits are the most important present and future aquifer in the State of Delaware. They are and will continue to be most valuable for water supply in Sussex and southern Kent counties. Other productive aquifers are the Manokin, Potomac, Piney Point, Cheswold, and Frederica formations, all of which have extensive supplies untapped at present.

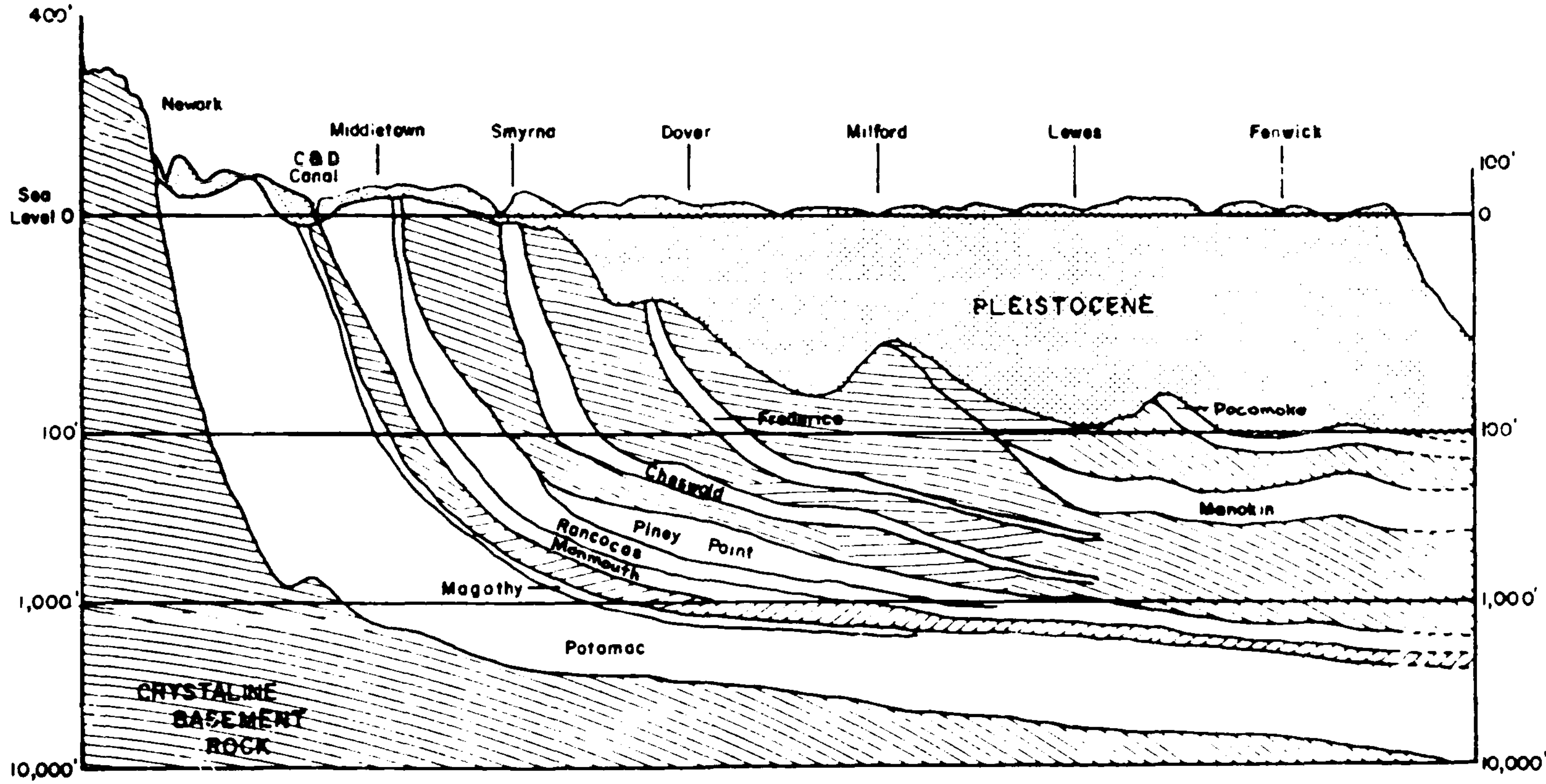
Aquifer Recharge: Figure 6 shows the outcrop areas of aquifers in Delaware, with the Pleistocene deposits removed. Pleistocene deposits cover the entire Coastal Plain in Delaware, but are so porous that underlying aquifers are recharged through them.

In two areas of the state, present groundwater withdrawals are approaching or exceeding recharge rates. These are the areas surrounding New Castle and Dover. Continued overpumping may result in saline intrusion and surface water pollution because of reduced stream flow.

Groundwater Quality: The most widespread groundwater quality problem in Delaware is saline encroachment. A high chloride concentration is natural within two miles of the Delaware Bay and within one mile of tidal streams. There is some evidence of increased saline intrusion caused by overpumping in the New Castle area. The dredging of the Lewes-Rehoboth Canal caused the unnatural infiltration of saline water into the normally fresh Pleistocene aquifer in the vicinity of the canal.

FIGURE 5

GEOLOGIC CROSS-SECTION
OF DELAWARE



Source: Delaware Water, Rasmussen, [illegible] and Beamer, Page 72.

TABLE 8: *Ground water available in Delaware from the drainage basins of the Delaware River and Bay and the Atlantic coast*

Aquifers in the vicinity of	Available supply	Developed supply	Remaining supply
	million gallons per day	*million gallons per day*	*million gallons per day*
Northern New Castle County:			
Piedmont crystalline	[1]<5	[1]<1	[1]0 <4
Piedmont limestone marble	[1]<2	[1]<1	[1]0 <1
Pleistocene Potomac subcrop	[1]20	[2]11.2	8.8
Canal area of New Castle County:			
Potomac aquifers	[2]11	4	7
Southern New Castle County:			
Potomac aquifers	[1]3	0	[1]3
Magothy aquifer	[1]2	.5	[1]1.5
Other Upper Cretaceous aquifers	[1]1	[1].2	[1].8
Rancocas aquifer	[1]2	[1]1	[1]1
Kent County:			
Rancocas aquifer	[3]3	.15	2.85
Piney Point aquifer	[3]8	1.5	6.5
Cheswold aquifer	[3]8	5.4	2.6
Frederica aquifer	[3]5	2.6	2.4
Pleistocene and subcrop aquifers	[3]80	6.5	73.5
Eastern Sussex County			
Cheswold and minor aquifers	[4]9.5	.4	9.1
Frederica aquifer	[4]3.5	.6	2.9
Miocene above Frederica aquifer	[4]5	.8	4.2
Manokin aquifer	[4]25	4	21
Pleistocene and subcrop aquifer	[4]100	12	88
Total	293	53	240

[1]Estimated

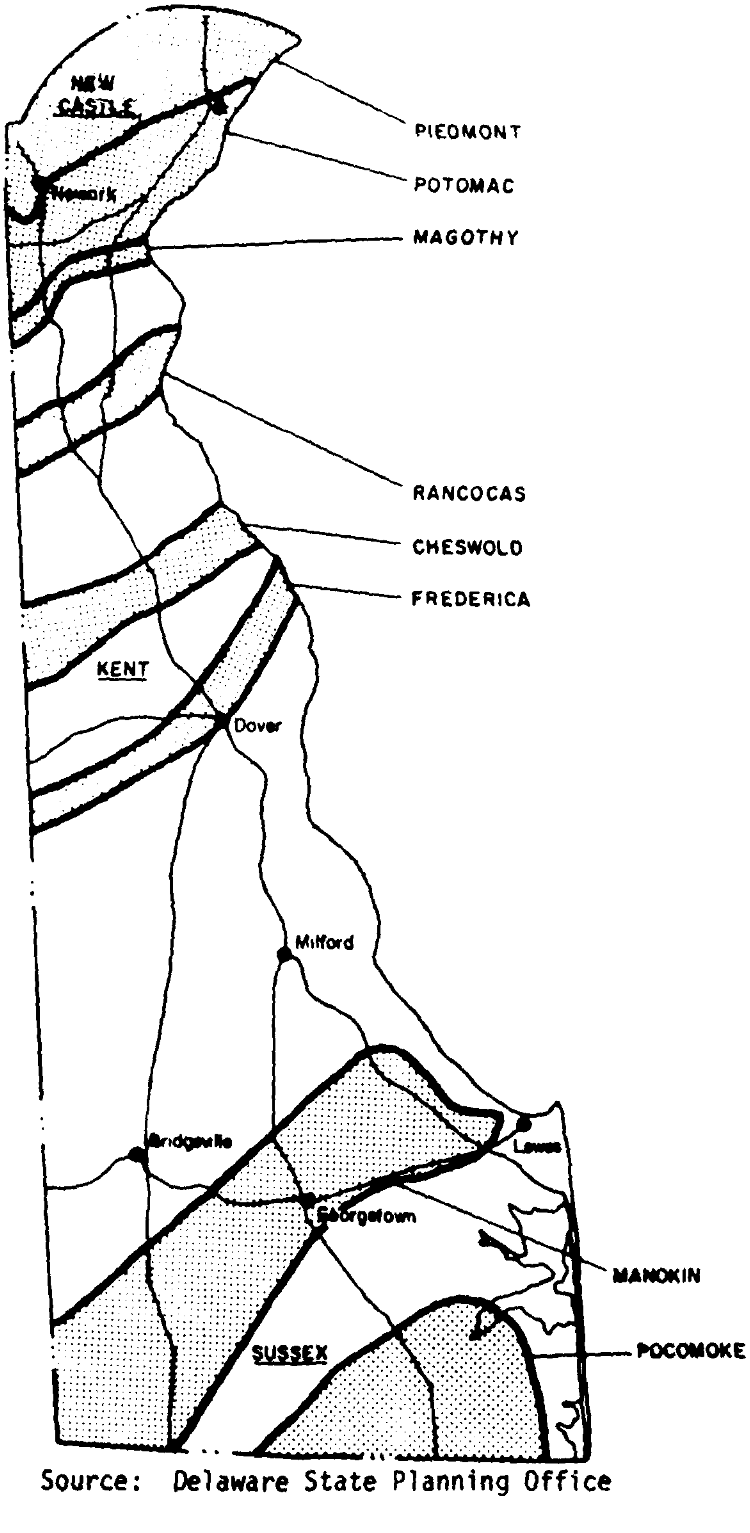
[2]Sundstrom, R. W. *et al.*, Availability of ground water from the Potomac formation in the Chesapeake and Delaware Canal area, Delaware, 1967. Water Resources Center, University of Delaware, Newark, Delaware.

[3]Sundstrom, R. W., and T. E. Pickett, Availability of ground water in Kent County, Delaware, 1968. Water Resources Center, University of Delaware, Newark, Delaware.

[4]Sundstrom, R. W., and T. E. Pickett, Availability of ground water in eastern Sussex County, Delaware, 1969. Water Resources Center, University of Delaware, Newark, Delaware.

Source: Sundstrom, R. W., and R. D. Varrin, Water supply and use in the drainage basins of the Delaware River system and Atlantic coastal drainage basins in Delaware, 1971, page 25. Water Resources Center, University of Delaware, Newark, Delaware.

FIGURE 6: AQUIFER OUTCROPS IN DELAWARE WITH PLEISTOCENE REMOVED



Source: Delaware State Planning Office

The quality of all of Delaware's groundwater resources is generally good, although local problems exist. The Potomac, Magothy and Rancocas formations are usually high in iron. Nitrate contamination is a problem near St. Georges in the Monmouth and Pleistocene deposits.

The presence of a very high water table in southwestern Kent County and northwestern Sussex County indicates that special care must be taken in these areas to avoid groundwater contamination.

Impacts of Dredging and Disposal Activities

Both dredging and dredged material disposal activities have the potential to adversely affect the groundwater supplies of the region. The Magothy-Raritan, Kirkwood-Cohansey, and Pleistocene deposits are the most important, and most vulnerable aquifers.

It has been noted that overpumping of the Magothy-Raritan Formation is causing induced recharge of the aquifer from the Delaware River. Below Camden, the aquifer is isolated from the river by thin deposits of silt on the river bottom. If these deposits are breached by dredging, induced recharge may be increased. The quality of groundwater in the Magothy-Raritan is highly dependent on the quality of water in the river itself. Breaching of the aquifer must be avoided where there is danger of salinity contamination or other pollution from the Delaware River.

In places where the Magothy-Raritan outcrop is unprotected by impermeable deposits, the aquifer is vulnerable to pollution from dredged material disposal. Care must be taken in the selection of disposal sites to avoid areas where induced recharge from leachate may contaminate the aquifer. Sediments dredged from the Delaware River contain heavy materials such as zinc, mercury, lead, arsenic and cadmium. The highly porous outcrop of the valuable Kirkwood-Cohansey aquifer borders the Delaware Estuary between Artificial Island in Salem County and Cape May. Direct deposition of dredged material on the outcrop area should be avoided unless this highly vulnerable aquifer is protected from infiltration of the leachate.

The Pleistocene deposits covering most of Delaware are highly vulnerable to dredged material disposal for many of the same reasons the Kirkwood-Cohansey aquifer is so sensitive. It is a water table aquifer, so leachate from disposal sites located anywhere on the aquifer's surface can potentially contaminate groundwater locally. Several other aquifers are recharged by infiltration through the Pleistocene deposits covering their outcrop area. The Potomac aquifer outcrops along the Delaware River between Bellefonte and Red Lion. The Cheswold and Frederica aquifers outcrop in the area of Bombay Hook National Widlife Refuge. The Manokin outcrop is located a few miles inland and northwest of

Lewes. The outcrop of the Pocomoke aquifer lies behind Indian River Bay. Dredged material disposal in these sections of the shoreline may pollute groundwater supplies. Special care must be taken near New Castle, where overpumping conditions will hasten infiltration of leachate into the Pleistocene and Potomac aquifers.

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WETLANDS

Introduction

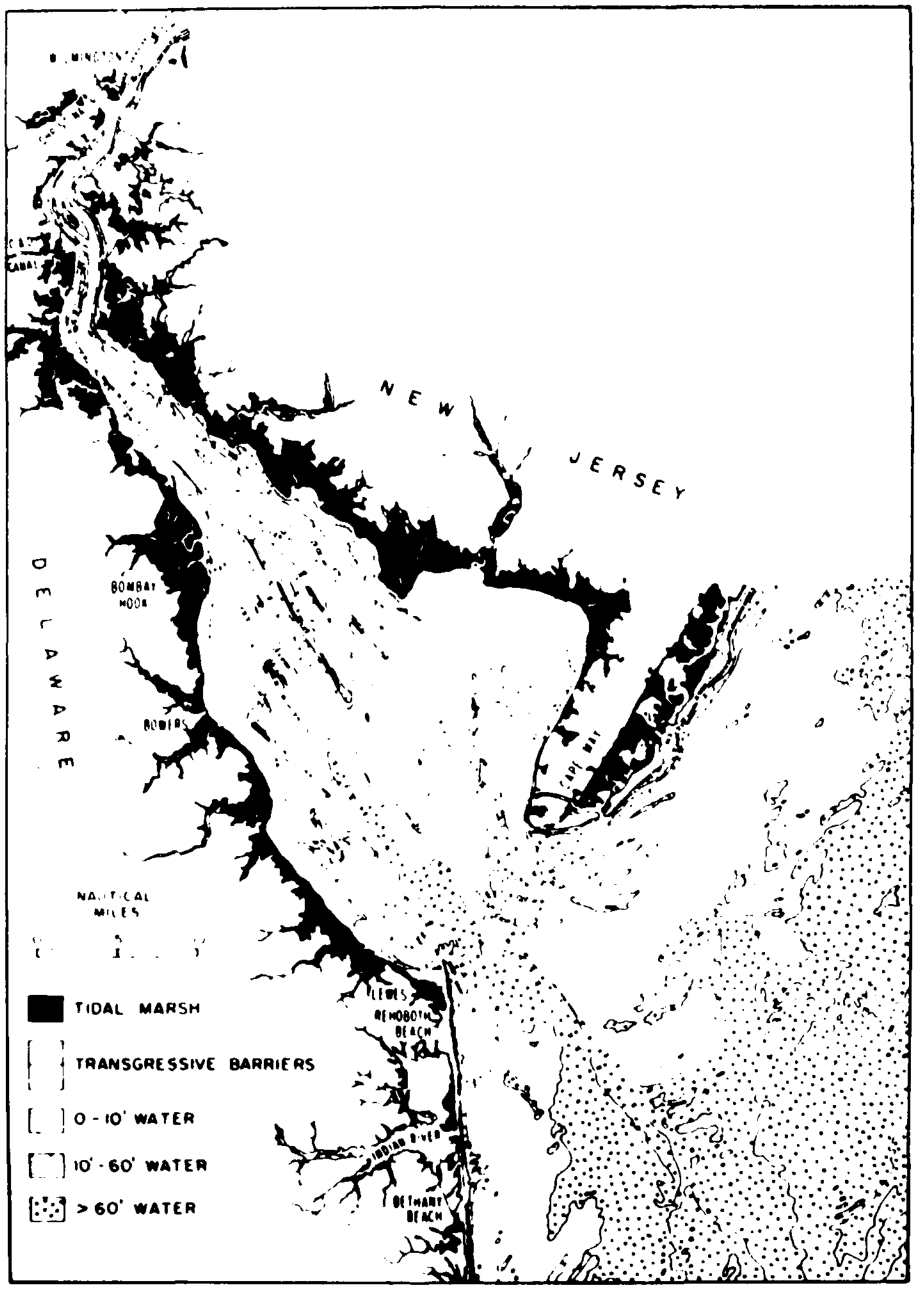
Historically, the Delaware Estuary between Trenton and the Atlantic Ocean, and all tidal tributaries, were abundantly fringed with lush wetlands. The characteristic salt marsh vegetation of the bay merged with freshwater marshes in the vicinity of New Castle and Salem counties. The values of these ecosystems were largely unrecognized in the past, and most of the wetlands on both shores north of New Castle and Camden have been eliminated by dredging or filled for development. For example, the Philadelphia International Airport rests almost entirely on filled wetlands. Extensive tidal wetlands in a largely natural state are abundant south of Wilmington and Gloucester County. Their extent is delineated in Figure 7. For a more detailed survey of wetlands from Trenton to the sea, refer to "The Delaware Estuary System, Environmental Impacts and Socioeconomic Effects - Delaware River Estuarine Marsh Survey," report by T. E. Walton and R. Patrick, 1973.

Wetlands are among the most productive ecosystems in the world, and our increased understanding of their important role in the maintenance of water quality and supply makes their further destruction highly undesirable. Wetlands vegetation provides food for a variety of wildlife, and tidal marshes are essential nurseries for economically valuable species such as shrimp and blue crab. Dense aquatic vegetation filters sediment and absorbs nutrients from polluted waters passing through the marsh. The absorbent substrate upon which wetlands grow, called peat, steadily releases large quantities of groundwater during dry periods and absorbs floodwaters, thereby helping to maintain water supplies. All of these valuable functions are on-going in healthy wetlands ecosystems, but these areas are very sensitive to environmental degradation. Some of the impacts of dredging and filling operations will be discussed following the inventory of wetlands in the study area.

Both tidal and non-tidal wetlands occur in the study area. Non-tidal marshes usually grow in freshwater along streams and in ponds. Bogs and swamps are also occasionally found in the study area. Tidal wetlands are flooded twice daily by tides, and it is this tidal fluctuation that maintains their high level of productivity. Tidal marshes thrive at all levels of salinity, which has been found to be the primary determinant of vegetational differences between fresh, brackish and saline marshes in the Delaware Estuary. Disturbances such as filling, ditching, and diking induce changes in vegetation. Table 9 contains a list of representative plant species for each kind of marsh, and species characteristics of disturbed wetlands.

Although it is very difficult to quantify the environmental values of wetlands, it is possible to rank the various types of wetlands by their general ecological importance.

FIGURE 7: MARSHES OF DELAWARE AND SOUTHERN NEW JERSEY



Courtesy of J. C. Kraft

Source: College of Marine Studies, University of Delaware, 1972, The Coastal Zone of Delaware.

TABLE 9

WETLANDS VEGETATION

Tidal and Non-Tidal Freshwater Marsh (natural)	
Common Threesquare	*Scirpus americanus*
Bullrush	*Scirpus olneyi*
Dotted Smartweed	*Polygonum punctatum*
Spikerush	*Eleocharis* sp.
Arrowhead	*Sagittaria* sp.
Wild Rice	*Zizania aquatica*
Arrow Arum	*Peltandra virginica*
Spatterdock	*Nuphar advena*
Pickerelweed	*Pontederia* sp.
Loosestrife	*Lythrum* sp.
Tidal and Non-Tidal Freshwater Marsh (disturbed)	
Common Reed	*Phragmites australis*
Brackish Marsh	
Wild Rice	*Zizania aquatica*
Cattail	*Typha* sp.
Saltwater Marsh	
Cordgrass	*Spartina alterniflora*
Salt Hay	*Spartina patens*
Spikegrass	*Distichlis spicata*
Saltwater Marsh (disturbed)	
Common Reed	*Phragmites australis*
Groundsel Bush	*Baccharis halimifolia*
Marsh Elder	*Iva frutescens*

Tidal wetlands, both fresh and saline, are the most valuable type of wetland ecosystem in the study area because they provide nutrients for estuarine and marine organisms. Those marine species which cannot migrate into the estuarine marshes are sustained by the regular tidal flushing of nutrients from the marshes into the estuary and the Atlantic Ocean.

Non-tidal wetlands are also valuable wildlife habitats and feeding grounds, and perform the same roles as tidal marshes in maintaining water quality and supply. Such benefits, however, are generally only of local importance, and for this reason non-tidal marshes are of slightly less overall value than tidal marshes.

The wetlands with the least environmental value are those which have been disturbed. The plant species inhabiting these areas are far less attractive to wildlife for forage than natural wetlands vegetation. Filling and diking interrupts tidal flooding, so much of the productivity of the marsh is lost. Disturbed marshes are not without value, however. They provide shelter for wildlife if not food, and are still important recharge areas for groundwater supplies.

Wetlands by County

Bucks County: No extensive tidal or inland wetlands are found in Bucks County. Small freshwater tidal marshes, each less than 25 acres in size, are growing at the mouths of Poquessing and Neshaminy creeks. The primary vegetation is spatterdock. Another small tidal marsh fringes part of Biles Island in Falls Township. Non-tidal marshes can be found along Scott's Creek (an extension of Manor Lake in Falls Township) and around Silver Lake, in the vicinity of Bristol Borough. Both of these areas are small.

Philadelphia County: Besides a small freshwater tidal wetland growing at the mouth of Pennypack Creek, the Tinicum National Environmental Center (TNEC) is the only wetland area in Philadelphia. One hundred forty-five acres of this wildlife preserve lie in the Eastwick area of southwest Philadelphia, north of the Philadelphia International Airport. This section of Tinicum Marsh is non-tidal, and is located along the shores of a lagoon impounded for wildlife habitat. Despite the urban nature of the area, the marsh is a valuable feeding area for wildfowl. Dominant species are spatterdock, loosestrife and cattail.

Delaware County: An additional 500 acres of the TNEC are located in Delaware County near the mouth of Darby Creek. The largest freshwater tidal marsh in Pennsylvania (320 acres) is part of the Center. The rest of the TNEC presently consists of diked or filled wetlands, with radically altered vegetation. The tidal portion is characterized by plants such as spatterdock, wild rice, and narrow-leaved cattail. The dominant vegetation in the diked areas is common reed, while filled areas support upland field and forest species. A 78-acre site, including 65 acres of water surface, represents lagoons dredged for fill for Interstate Route 95. These lagoons are fringed by tidal wetlands, and will eventually be annexed to the TNEC.

Mercer County: The Trenton Marsh, located at the mouths of Crosswicks, Doctors and Back creeks behind Duck Island, is considered the largest freshwater tidal marsh on the East Coast. It is 470 acres in size, and supports characteristic freshwater tidal marsh vegetation. Like Tinicum Marsh in Delaware County, these valuable wetlands have been extensively altered by man's activities. Trenton Marsh is the only wetland inventoried in Mercer County.

Burlington County: The few remaining wetlands near the Delaware River in Burlington County support mixed freshwater tidal species of vegetation. Marshy patches from 25 to 50 acres in size are scattered along the lower two miles of Assiscunk Creek. Larger wetlands stands grow along both branches and the main stem of Rancocas Creek up to 10 miles inland. The only other stand of tidal wetlands along the Delaware is a 50-acre site located inside a lagoon at the mouth of Craft's Creek.

The extreme southeastern end of Burlington County borders the Great Bay, a small bay of the Atlantic Ocean. Tidal saltwater marshes are abundant in this area and along tidal reaches of the Mullica and Wading rivers, which are tributary to Great Bay.

A large portion of southeastern Burlington County is in the Pine Barrens--a vast forest covering most of southern New Jersey. Swamps are common throughout the Pine Barrens in areas with extremely poor drainage such as floodplains and other low-lying sites. The characteristic swamp forest species is Atlantic or southern white cedar (Chamaecyparis thyroides). With time, cedar swamps become southern hardwood or maple-gum-magnolia swamps. Examples of both swamp types occur in Burlington County. Cranberry bogs are also scattered throughout southeastern Burlington County. The water level in these wetlands is artificially maintained for agriculture.

Camden County: Wetlands adjacent to the Delaware River are also sparse in Camden County. The only wetlands mapped during an inventory taken in 1973 are a 50-acre freshwater marsh along the back channel behind Petty Island, and a marsh slightly greater than 100 acres located inside a bay on the Pennsauken Township shoreline, just north of Petty Island. Very small, isolated, freshwater wetlands are scattered along Big Timber Creek.

White cedar and maple-gum-magnolia swamps are commonly found in lowland areas in the Pine Barrens of southeastern Camden County.

Gloucester County: The abundance of tidal wetlands begins to increase in New Jersey south of Camden. Wetlands occupy 13,567 acres, or 6.5% of Gloucester County. Extensive freshwater marshes are common along tidal reaches of Big Timber, Woodbury, Mantua, Raccoon and Oldman's creeks. Approximately 100 acres of mixed saltwater marsh

vegetation grows along Mantua Creek near its confluence with the Delaware. The major saltwater species in this area is cordgrass. An extensive mixed freshwater marsh is located along the Delaware behind Monds Island. South of Raccoon Creek, a 500-acre tidal marsh site has been disturbed. Common reed is the dominant plant here. White cedar and maple-gum-magnolia swamps are found in lowland sections of the Pine Barrens in southeasern Gloucester County.

Salem County: Due to the increasing salinity of the Delaware River in the vicinity of Salem County, the vegetation of coastal wetlands begins to be characterized by the presence of salt-tolerant species. Marshes in brackish areas support saline and freshwater species tolerant of low levels of salinity. Wetlands are sparse along the Delaware River shoreline until below Pea Patch Island, where common reed and cordgrass marshes become very extensive. Common reed is evidence of diked or otherwise altered marshland. South of Artificial Island, wetlands vegetation characteristic of brackish conditions extends over three miles inland, and even farther along streams. Just north of the Cumberland County border, salt hay and spikegrass appear. The presence of these species indicates high salinity in the Delaware Estuary.

Brackish or saline marshes merge into freshwater wetlands and extend up to ten miles inland along tidal streams in Salem County. Freshwater marshes are widespread along Alloway Creek, Salem River, Mannington Creek and the Mannington Meadow above Salem City. Large stands of valuable wild rice grow in the wetlands around Salem City. In total, there are 28,000 acres of tidal marsh in Salem County (this figure includes surface water area).

Approximately 25 lakes are located in Salem County, and typical freshwater marsh species inhabit their shores. Other inland wetlands include the maple-gum-magnolia swamps of the Pine Barrens in the southeastern interior portion of Salem County.

Cumberland County: The entire southern boundary of the county, in seven municipalities along Delaware Bay, is dominated by tidal wetlands from one to five miles wide. Wetlands extend even farther inland along tidal streams, reaching to Bridgeton on the Cohansey River and Millville on the Maurice River. Approximately 20% of the total Cumberland County acreage is tidal wetlands vegetation.

The brackish Cohansey River supports large stands of cordgrass and common reed in the tidal reach. South of the mouth of the Cohansey, the higher salinity of the Delaware Bay allows salt hay to thrive, as well as mixed saltwater-tolerant species. In general, cordgrass and salt hay each account for about 45% of the tidal wetlands vegetation in the county, with mixed species making up the other 10 percent. Inland along the Maurice River, freshwater conditions influence the tidal marsh composition, and large pure stands of wild rice are abundant.

Pine Barrens vegetation covers most of inland Cumberland County. Swamp communities of white cedar and maple-gum-magnolia are scattered in low-land and floodplain areas.

Cape May County: Tidal wetlands account for 38% of the total county land area. Most of these wetlands are in their natural state, and grow behind the barrier islands on the Atlantic coast. Along the Delaware Bay, wetlands grow most extensively in the first six miles of shoreline below Cumberland County. Here, the cordgrass and salt hay marsh extends almost five miles inland along Dennis Creek. Along the Cape May peninsula, wetlands narrow to widths of one mile or less. Some sections have been extensively ditched for mosquito control, and these are dominated by common reed vegetation. The only wetlands south of the town of North Cape May are 250 acres of common reed along the Cape May Canal and 500 acres of common reed behind Higbee Beach.

Northern Cape May County is part of the Pine Barrens forest, so white cedar and maple-gum-magnolia swamps are distributed throughout this area.

New Castle County: New Castle County has 23,700 acres of tidal wetlands, and most are situated south of the Chesapeake and Delaware Canal. Between the Christina River and Silver Run, the only wetlands that occur have been disturbed and are characterized by the dominance of common reed. The only stand of common reed marsh greater than 200 acres in size is located along St. Georges Creek, immediately south of the canal. This marsh covers approximately 600 acres. Many smaller stands of common reed are scattered along the twelve-mile tidal reach of the Christina River.

South of Silver Run, the marshes are much larger, and the dominant plant species becomes cordgrass, reflecting the increasing salinity of the tidal waters. Cordgrass marshes line Appoquinimink Creek to Odessa and Blackbird Creek to Blackbird Landing. This vegetation merges with mixed freshwater species as the water in tidal streams changes to brackish and fresh in upstream reaches. South of Blackbird Creek, salt hay and spikegrass are dominant along the Delaware Bay shoreline, with cordgrass more commonly found on the inland side of the marshes. Salt hay and spikegrass grow along the lower two miles of the Smyrna River, while cordgrass is found along this tidal stream as far west as the town of Smyrna. There are numerous shallow, groundwater-fed ponds in southern New Castle County. Freshwater marshes are common in such ponds and along freshwater streams.

Kent County: Nearly half of the State of Delaware's total wetland acreage, over 50,000 acres, is located in Kent County. Wetlands vegetation extends the entire length of the county's 35-mile Delaware Bay shoreline. Marshes are widest in the vicinity of Bombay Hook, (four

miles), but in the south, peninsulas of stable land dissect the wetlands. Four marshland-oriented conservation areas, the largest of which is Bombay Hook National Wildlife Refuge, are located in Kent County and include 23,000 acres of wetlands. The expansive Bombay Hook wetlands support primarily cordgrass, salt hay and spikegrass, but the vegetation changes to mixed freshwater species eight miles inland along the Leipsic River. At least 1,000 acres of freshwater marsh are located along the estuary shoreline north and south of Little River. Arrow arum and spatterdock are the dominant species in this area. Another smaller freshwater marsh is located along the estuary north of the St. Jones River.

The saline marshes at the mouths of the St. Jones and Murderkill rivers have been extensively ditched for mosquito control, so stands of common reed, marsh elder and groundsel bush are scattered throughout the wetlands. These are also the dominant species in a three-mile stretch between Sandy Point and Big Stone Beach. The wetlands along the southern shoreline are narrower than in the north of Kent County, and are usually less than two miles deep. They reach much farther inland along the tidal rivers, and cordgrass borders the St. Jones to Dover Air Force Base and occurs four miles inland at Frederica on the Murderkill. The Milford Neck Wildlife Area north of the Mispillion River is primarily a cordgrass marsh, though other grasses are also common. Three miles inland along the Mispillion, freshwater species dominate and grow extensively up to one mile south of Milford.

The extremely poor drainage of the western half of Kent County has caused many small ponds to form. As is the case in New Castle County, freshwater wetlands vegetation is commonly found in these swampy areas.

<u>Sussex County</u>: Most of Sussex County's 30,000 acres of wetlands are found in protected lagoons behind the barrier islands along the Atlantic coast. In general, the marshes of the Delaware Bay shoreline segment have been extensively ditched and filled, and pure stands of natural wetlands vegetation are infrequent. One such natural area lies between the Mispillion River and Fowler Beach where the dominant plants are cordgrass, salt hay and spikegrass. These wetlands are narrow, ranging from one-quarter to one mile wide. Between Fowler Beach and the Broadkill River, disturbance has almost eliminated natural tidal species, and common reed, marsh elder and groundsel bush are the most common plants found. The cordgrass marsh south of the Broadkill River extends six miles inland to Milton.

A large tidal marsh is located adjacent to the Lewes-Rehoboth Canal throughout most of its length. The wetlands area is larger on the northeast side of the canal. Cordgrass is the dominant species, but the presence of some non-natural vegetation indicates disturbance has occurred. At each end of the canal, on the northeast side, some freshwater wetland species can be found.

Tidal marshes dominated by cordgrass surround the lagoon areas of Indian River and Rehoboth bays, and merge with freshwater vegetation in the tidal reaches of the bays' tributaries. Intense development pressure in the area has led to the destruction of much of the wetlands vegetation. Stands of common reed mark wetlands which remain unfilled, but have been disturbed in some way. Filling operations have disrupted the continuity of the once expansive marshes, and most remaining stands of wetlands vegetation are each less than 150 acres in size.

A cypress swamp is situated in southern Sussex County west of Selbyville. Although the cypress originally covered over 10,000 acres, most of this species was replaced by cedar following a large storm over 100 years ago. Nevertheless, this area is unique in the study area, as cypress is usually found growing much farther south. The high water table is the key to the perpetuation of the cypress swamp.

Impacts of Dredging and Disposal Activities

The direct dredging of wetlands and deposition of dredged material immediately on top of wetlands destroys this valuable habitat and alters environmental conditions in the remaining wetlands. Dredging of marshland changes the flow pattern and salinity within adjacent wetlands. Disposal of dredged material in part of a large wetland area will also drastically alter the hydrologic regime of the remaining area.

Not all of the wetlands inventoried are equally vulnerable to dredged material disposal. Some of the wetlands have been described as "disturbed," based on the presence of vegetation uncharacteristic of pristine marshland. Such habitats are less productive than the natural tidal marsh, and do not play as essential a role in the maintenance of water quality. In some cases, however, pockets of disturbed vegetation in the midst of a tidal marsh of uniform composition attract new wildlife species because of the diversity provided by the disturbed vegetation. In general, any habitat which is locally unique should not be destroyed, regardless of how ubiquitous it may be several miles away.

Although all tidal wetlands should be avoided when choosing disposal sites for dredged material, a few of the wetlands inventoried are specially important. The few remaining tidal wetlands between New Castle and Morrisville on the western shore of the estuary and between Camden and Trenton on the New Jersey side must be preserved. They provide unique habitats in an otherwise urban environment which are of immeasurable ecological and educational value. Tidal marshes have also been virtually eliminated from the Delaware Bay shoreline of lower Cape May County, and the remaining wetlands, though disturbed, should be preserved.

Preservation of tidal marshes is also especially important where water quality is poor. Unfortunately, degradation of streams can usually be correlated with large-scale filling of wetlands. Some of the degraded streams which are still fringed by wetlands, however, sparse, are:

Stream	Location
Delaware River	New Castle to Trenton segment
Neshaminy Creek	Bucks County
Pennypack Creek	Philadelphia County
Darby Creek	Delaware County
Crosswicks Creek	Mercer County
Assiscunk Creek	Burlington County
Big Timber Creek	Camden and Gloucester Counties
Oldman's Creek	Gloucester County
Raccoon Creek	Gloucester County
Mantua Creek	Gloucester County
Salem River	Salem County
Alloway Creek	Salem County
Cohansey River	Cumberland County
Maurice River	Cumberland County
Christina River	New Castle County
St. Jones River	Kent County
Broadkill River	Sussex County
Rehoboth Bay and tributaries	Sussex County
Indian River Bay and tributaries	Sussex County

Creation of new tidal wetlands from strategically placed dredged material is becoming increasingly successful as research continues. Such activities should be encouraged in those parts of the estuary where poor water quality conditions occur in conjunction with a lack of tidal wetlands.

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VEGETATION

Introduction

Among the many environmental factors important in determining vegetation patterns are soil and topography. Because these two features are quite variable within the study area, there is a great diversity in vegetation as well. Natural vegetation has been disturbed to a great extent by urban development in the northern half of the study area, and by agriculture in the southern section. However, significantly large wooded and open areas, as well as extensive wetlands, remain. The discussion of wetlands is included in a separate section of this report.

The maintenance of land in natural vegetation is important for a number of reasons. Dense root and stem structures slow runoff and conserve valuable topsoil. By preventing erosion and absorbing precipitation, stands of vegetation protect water quality and supply. Even small woodlots break the force of winds and help to moderate temperatures. Both woodlands and open fields are important habitats for wildlife.

All of these values of natural vegetation are destroyed if such areas are used for the deposition of dredged material. Natural vegetation is smothered by dredged material, and wooded areas must be cleared before they can be used for disposal sites. Therefore, it is important to know the existing pattern of vegetation in areas being considered for disposal of dredged material. In the following inventory, the general pattern of vegetation in each county will be presented, along with a more detailed evaluation of the vegetation of shoreline areas.

Vegetation by County

Bucks County: Woodlands are most extensive in upper Bucks County. In the Reading Prong portion of the county, chestnut oak is the dominant hardwood species on ridges, along with hemlock and white pine. Foothill forests are characterized by mixed oak species. Several different hardwood forest associations are common in the Piedmont. Among these are the red and black oak association, beech association, and a tulip poplar association in moist areas. Large areas have been cleared for farming in central Bucks County.

The drier portions of the Coastal Plain in Bucks County are populated by pitch pine, Virginia pine, and assorted oaks and shrubs. Where more moisture is found, red maple, sycamore and sweetgum are common. Much of the land in the Coastal Plain has been cleared and developed.

Approximately 40% of the Bucks County shoreline is developed for intensive urban and industrial use. Another 50% of the shoreline is in open fields vegetation, agriculture or other open space. Woodland vegetation is limited to woodlots of 150 acres or less, and occupies less than 10% of the shoreline area. The forest species are typical of the Coastal Plain species listed above. In addition, some individual specimens of valuable hardwoods such as elm and black walnut have been observed on Biles Island in Falls Township.

Philadelphia County: Most of the Philadelphia area is urbanized and cleared of extensive natural vegetation, except in portions of Fairmount Park and the steep valleys of the Wissahickon, Pennypack, and Poquessing creeks. Where large stands of trees still exist, their species composition is comparable to that found on similar topography in Bucks County. The only large amount of open land remaining is in Fairmount Park, though the vegetation is primarily mowed lawn, and would not occur naturally.

The entire Philadelphia section of the Delaware River shoreline is characterized by intensive urban development. The only exceptions are a 25-acre woodlot on the north shore of the mouth of Pennypack Creek, and an open field on the south side of the same creek.

Delaware County: Although Delaware County was originally densely wooded, only scattered second and third growth stands remain. The principle forest types, found predominantly on steep slopes, along streams, and in woodlots, include red oak, yellow poplar, black ash, sugar maple, pitch pine, and Virginia pine. The most extensive woodlands occur in the relatively undeveloped northern and western portions of the county. Tyler and Taylor arboretums preserve some outstanding forest specimens.

Ridley Creek State Park (2,613 acres) and large farms and estates contribute large amounts of open space to the county's natural environment. Besides supporting large mature woodlands, such tracts also contain abandoned fields colonized by grasses and small trees.

Virtually no open spaces interrupt the continuous urban and industrial shoreline in Delaware County. Some open areas exist between the developed riverfront uses and Darby Creek in Tinicum Township, and on Little Tinicum Island. These areas represent filled wetlands, and are colonized by grasses, shrubs, and young trees such as willow, red maple, white ash, sycamore and cottonwood.

Mercer County: In Mercer County, woodlands remain only on the steeper diabase ridges of the Piedmont and swampy areas of the Coastal Plain underlain by clay. Northern hardwood species grow in upland areas, and species such as beech, red cedar, pin oak and sweetgum can be expected to grow in wet clay areas.

The lower Piedmont valleys and sandy Coastal Plain areas have been cleared for farming. Nearly two-thirds of Mercer County was classified as rural in 1974 (including farmland, woodland, floodplains and open space) and 40% of that open land was used for agriculture.

The Mercer County shoreline below the falls at Trenton is developed south to Crosswicks Marsh. Only small pockets of open field vegetation exist along the waterfront on portions of the marsh which have been filled.

Burlington County: The four general types of vegetation identified in Burlington County include:

- Pine Barrens - covering the outer Coastal Plain region
- North American Woodland - most of the undeveloped inner Coastal Plain
- Freshwater aquatic - along freshwater streams
- Tidal Marsh

The tidal marshes of the Delaware riverfront region will be discussed in another section. Lowlands in freshwater areas are grassy, with some stands of river birch, wild black cherry, white elm and willow on the flood plains. Dry, sandy areas have been colonized by grasses and willows. Wooded upland sections support beech, hemlock, hickory, oaks and pines. The interior of the county has a wider variety of tree species than the coastal region.

The Pine Barrens are a unique feature of the outer Coastal Plain of New Jersey. They consist of a uniform oak-pine forest which appears to have been maintained in this composition by periodic fires. Several unique and rare plant and animal species are found in the Pine Barrens, but due to the distance from the Delaware River (fifteen miles in Burlington County), this area will not be discussed in greater detail.

At least three-quarters of the riverfront in Burlington County is heavily developed. Approximately 150 acres on Burlington Island are wooded, and smaller woodlots are scattered along the river below the mouth of the Rancocas River and on both sides of the back channel behind Newbold Island. Open land occurs at intervals along the shore, but is rarely more than one mile in length. Many of these spaces represent dredged material disposal sites. Where vegetated, they support mixed grasses and scrubby willows, black cherry and river birch.

Camden County: The vegetation pattern of Camden County is similar to that of Burlington County. The southern half of the county, corresponding to the Outer Coastal Plain, is predominantly covered by Pine Barrens forests. The Inner Coastal Plain is extensively developed, but hardwood forest species remain along floodplains and steep slopes.

Virtually all of the Camden waterfront is urbanized. The southern half of Petty Island in the Delaware River is open land, with trees growing on about 25 acres.

Gloucester County: Historically, all of Gloucester County was forested, though now only one-third of that woodland area remains. Most of the woodland occurs in the southern half of the county. In fact, 57% of all woodlands are found in two townships, Franklin and Monroe. In the northern portion of the county, woodlands are restricted to the banks of tidal streams and tributaries.

The southern forests in the Pine Barrens are primarily coniferous, including pitch pine and Atlantic white cedar. Most of the county's prime woodlands (forests which are particularly extensive, dense, or diverse) are found in the south. Prime woodlands cover more land area in the south than any other type of land use.

The opposite is true in the northern half of Gloucester County. The relatively small stands of trees here are primarily deciduous. Ash, red oak, sycamore and elm are common on alluvial land. Wet inland areas support pin oak, willow oak and sweetgum species. Mixed oaks and yellow poplar grow on better-drained inland soils.

In contrast to the shorelines of the six counties discussed above, the Gloucester County waterfront is largely undeveloped. Scattered deciduous woodlands grow on the banks of some tidal streams, on Monds Island, and on the shoreline behind Chester Island and Monds Island. The most extensive wooded areas along the Gloucester County shoreline are found at the latter site. At one point the woods are over one mile deep. Approximately half of the shoreline is open space, consisting of oldfields, agricultural land, and low density residential areas.

Salem County: Deciduous and coniferous forests cover 51,473 acres in Salem County. Deciduous woodlands are more abundant than coniferous, and are concentrated in Pittsgrove, Alloway and Quinton townships. Species composition of these forests is mixed, and includes several types of oak, yellow poplar, sweetgum, ash, willow, magnolia, maple, chestnut, hickory and beech. The abundance of various species within any particular stand is linked to local environmental conditions.

Coniferous forests cover a relatively small area of the county, and support a variety of pines. The largest stands occur in Quinton Township; smaller stands are scattered in Alloway and Lower Alloways Creek townships. A significant stand of Atlantic white cedar is growing in Lower Alloways Creek Township, above Maskell's Mill. White cedar stands are considered "endangered" by the New Jersey Department of Environmental Protection. Rare forest communities such as this white cedar stand should not be used as dredged material disposal sites.

Except for urban development in the vicinity of Penn's Grove, Deepwater and Penn's Beach, the Salem County shoreline is generally open. Most of the southern half is wetlands. The central portion of the waterfront is characterized by open fields interspersed with marshes. Agriculture is a common land use within one mile of the Delaware River. The Killcohook National Wildlife Refuge (legally part of New Castle County, Delaware) is actually a dredged material disposal area. Deciduous woodlands occur along the waterfront only on small parcels of 50 acres or less in Pennsville and Elsinboro townships. Species composition in these woodlands is mixed.

Cumberland County: One-quarter of all land in the county is in agricultural production, with most farmland concentrated in the north-central tier of municipalities. Approximately 119,000 acres, or 40% of the county, is privately owned woodland. Maurice River Township alone accounts for 32,000 acres of woodland. These forests are primarily owned by sand mining companies, and are growing over their future sand supplies. A large portion of the northeastern half of the county supports Pine Barrens vegetation.

Except for one mile of urban development at Fortescue, the entire Cumberland County segment of the Delaware Bay shoreline is tidal marsh.

Cape May County: Undeveloped woodland comprises the largest single land use in Cape May County, covering 48% of the entire county. Most of the forest vegetation grows on the upper and central portion of the Cape May mainland. These woodlands have been classified as primary and secondary, depending on their economic and wildlife value. Most large stands of both categories are found in Upper, Dennis and Middle townships. The amount of farmland in the county has declined from 64,000 acres to 10,000 acres in the past 100 years. Most agricultrual land lies in a belt along Routes 9 and 47, above and below the canal in Lower Township.

The only shoreline areas vegetated by non-wetland species occur in the central and southern portions of Cape May County. North of the canal, woodlands occasionally larger than 100 acres border the wetland fringe. Agricultural fields are also common along this section of the bay shoreline.

The Higbee Beach-Pond Creek Meadow area between Cape May Point and the canal in Lower Township has been designated an Area of Particular Concern by the New Jersey Coastal Zone Management Program and has been purchased by the state. A unique combination of dune, woodland, open field, and wetland vegetation grows on these 440 acres. Because of its uniqueness as a natural area, dredged material disposal would be detrimental to this site.

New Castle County: The hardwood forests of New Castle County are steadily being converted to residential use. A total of 56,800 acres remained in 1972. Oak-hickory forests are concentrated in the north and northwest, on steeper areas of the Piedmont. Limited oak-gum-cypress forests grow in the southwest corner of the county.

Intensive development characterizes the shoreline north of Wilmington, though a narrow strip of land remains open along the railroad right-of-way. Many open areas occur close to Wilmington; they represent dredged material disposal sites. Small woodlots and fields are scattered throughout the marshes below Delaware City. Woodlands of oak-red maple-sweetgum composition usually occur in a transition zone between the wetlands and open farmland or abandoned fields.

Kent County: The soils of Kent County are generally highly suitable for woodland growth. Poor drainage over much of the county limits the feasibility of agriculture and urban development, so forests are extensive. The western side of Kent County is almost entirely covered by an oak-hickory forest. Oak-gum-cypress woodlands are scattered throughout the same area and the center of the county. Kent County represents a transition zone between northern and southern forest types, and the oak-pine forests of southern Kent County are evidence of the increasing occurrence of southern species.

Tidal marshes along the shoreline are interrupted only by filled land at Woodland Beach, Bombay Hook and Bowers. A narrow sand beach appears sporadically on the bay side of the marshes.

Sussex County: Coniferous forests are very extensive in Sussex County, covering more than 250,000 acres (1957). These forests are predominantly composed of southern yellow pine, and they play an important role in national timber production. Oak-pine forests are scattered throughout the central and eastern parts of the county, and a stand of cypress is growing in the south along the Maryland border.

The Delaware Bay shoreline is characterized by tidal marshes flanked by a narrow beach. Urban development occurs at Slaughter Beach, Broadkill Beach, and Lewes Beach. Beginning at Cape Henlopen, dune vegetation takes the place of wetlands.

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WATER AND SHORE-BASED RECREATION

Introduction

The nationwide trends of increasing population, income, and leisure time combine to create a growing demand for outdoor recreation. Swimming, boating and fishing are among the most popular activities in the nation, and both picnicking and sightseeing are enhanced by the proximity of water.

The following discussion of the supply and demand for recreation demonstrates that the need for additional recreation sites is greatest near the population centers in New Castle County, the Pennsylvania counties and the three most northern New Jersey counties in the study area. Unfortunately, the waterfront is so intensively developed in these counties that public access to the estuary has been virtually eliminated. Existing and future dredged material disposal sites may prove to be the key to providing the recreational waterfront land these counties lack.

Recreation Analysis by County

Bucks County: A poll taken in 1970 determined that all water-oriented sports are particularly important to Bucks County residents, and that swimming is the most popular outdoor activity. Although the quality of the Delaware River limits its use for primary contact recreation, the river represents an excellent resource for residents of lower Bucks County who enjoy boating and fishing.

There is a significant deficit in the supply of swimming, boating and fishing sites in Bucks County. Existing public boating facilities include the Bucks County Delaware River Access Area, Neshaminy State Park, and the Falls Township Delaware River Access Area. The Bucks County Delaware River Access Area is an eight-acre site in Bensalem Township. This multipurpose park provides public boat launching facilities. Fishing and sightseeing are also possible. The marina and boat launch facilities at Neshaminy State Park are very heavily used. An estimated 18,500 visitors used the boating facility in 1976. The Falls Township Delaware River Access Area is being developed for boat access, fishing and picnicking. The Penn-Warner Club on Manor Lake in Falls Township is a private facility providing camping, boating, fishing, and picnicking opportunities.

Pennsbury Manor State Park is widely recognized for its scenic vista of the river, and picnicking facilities are available. Another opportunity for passive enjoyment of the river exists along Radcliffe Street in

Bristol Borough's historic district. This area provides a combination of historical and waterfront sightseeing unique in Bucks County. The Pennsylvania Coastal Zone Management Program has identified a ten-mile segment of the historic Pennsylvania Canal between Bristol and Morrisville boroughs as having potential for hiking, biking and fishing.

The large lake at Nockamixon State Park in upper Bucks County will continue to satisfy much of the demand for water-oriented recreation in Bucks County. The extensive waiting list for marina facilities at Neshaminy State Park and heavy use of existing launching ramps indicate continuing demand for boating access to the Delaware River. Use of existing and potential dredged material disposal sites for public waterfront access should be investigated to augment existing sites. Disposal sites, however, must be given time to dry and settle before being used for recreation.

Philadelphia County: Poor water quality once caused Philadelphia residents to ignore the Delaware River as a potential recreational resource. The great popularity of the waterfront promenade and boat basin at Penn's Landing, however, indicates a recent renewal of interest in the Delaware River. Water quality improvement has played a large part in enhancing the attractiveness of the Delaware River to residents and visitors. Penn's Landing does not provide marina or boat launching facilities, and the only existing public launching ramp is at Pleasant Hill Park, in northeast Philadephia. Seven private marinas are located along the Delaware north of Frankford. There is a great need for additional public boat access points in Philadelphia. Both Fort Mifflin and Penn Treaty Park are local recreational resources providing scenic vistas of the river in historic settings. Fishing is also popular at Penn Treaty Park. The Schuylkill River Park, presently under development between South Street and the Philadelphia Art Museum, will be used for sightseeing and biking. Wildlife observation and picnicking can take place in a serene lake setting at the Tinicum National Environmental Center in the Eastwick section of Philadelphia.

The demand for access to the Delaware River is expected to increase in Philadelphia as water quality improves and public awareness of the recreational assets of the river is heightened. However, intensive waterfront development for commercial use continues to limit public access to the river. The use of recreational easements on vacant private land and development of existing dredged material disposal sites for recreational use must be encouraged to satisfy the growing demand in Philadelphia for access to the Delaware River.

Delaware County: The only existing sites for public access to the Delaware River in Delaware County are tiny McClure Park in Marcus Hook and Governor Printz Park in Essington. Although small, both areas provide vantage points for observing shipping activities on the river,

and their significance is heightened by the scarcity of public access in Delaware County. The U.S. Fish and Wildlife Service is presently completing plans for the development of habitat areas and recreation facilities in the Tinicum National Environmental Center. The lagoon areas of the TNEC are already used extensively by local residents for fishing, boating, and even water-skiing, though bodily contact with the Darby Creek and Delaware River waters is not recommended.

The Pennsylvania Coastal Zone Management Program has identified the Essington waterfront, Little Tinicum Island, the Chester Creek mouth and a vacant site adjacent to the Commodore Barry Bridge as areas with immediate potential for recreational development. The eleven private marinas and one seaplane base (as of 1976) along the Essington waterfront in Tinicum Township are not operating at full capacity. Shoaling in the back channel of the Delaware behind Little Tinicum Island has limited use of the marinas to vessels drawing less than 4 feet. Maintenance dredging will be necessary to restore the attractiveness of this waterfront to boaters. Little Tinicum Island is adjacent to Essington, and has potential for sightseeing and fishing activities. Both the mouth of the Chester Creek and the waterfront land under the Commodore Barry Bridge are vacant or under-utilized. They represent potential sites for boat access and passive enjoyment of the riverfront.

Water-based recreational use of the river in Delaware County has been limited by degraded water conditions and lack of public access. Residents have been forced to look outside the county for boating and fishing opportunities, but can be expected to frequent any future access areas on the Delaware River. The dredged material disposal sites on Little Tinicum Island could be developed for recreational use and would be used as such, if boating access was available both on shore and on the island. Similar use of other disposal sites should be investigated.

<u>Mercer County</u>: New Jersey's Statewide Comprehensive Outdoor Recreation Plan (SCORP) combines Mercer County with Somerset and Middlesex counties to form the Central Corridor Region. The figures cited below combine recreation supply, demand and deficit data from all three counties. Rapid urban and suburban growth has led to a critical deficit of recreational land in the Central Corridor Region. Water pollution and lack of access in the vicinity of Mercer County generally limits the use of the Delaware River for water-based recreation. In Mercer County at the present time, the Delaware-Raritan Canal is heavily used for canoeing, boating and fishing. The inland lakes, ponds and reservoirs are available for boating, swimming, and fishing. However, lack of access to these sites limits their usefulness to the general public as well.

Demand for swimming, boating and fishing opportunities is expected to exceed the developed supply of the region in 1985, and will jump to deficits of 64,100 person-days for swimming, 25,211 person-days for boating, and 8,316 person-days for fishing by the year 2000. New access points and launching ramps along the Delaware River would satisfy a large portion of the boating demand, and the feasibility of using dredged material disposal sites as access points in Mercer County should be investigated.

Burlington: Burlington County, Camden and Gloucester counties are combined for recreational analysis in New Jersey's SCORP. These counties, called the Southwest Region, have an aggregate deficit of 20,000 acres of recreational land, which will increase 75% by the year 2000. The deficiency is most severe along the developed Delaware River portion of the region. Although the present demand for swimming facilities is being met, a deficiency of 25,500 person-days of swimming is anticipated by the year 2000. A 1970 deficit of almost 2,700 person-days of boating may increase to 20,300 person-days in the year 2000.

Several state forests in the Pine Barrens of Burlington County provide opportunities for boating, canoeing and swimming. These areas, however, are inaccessible to much of the county's population, concentrated along the Delaware River. Use of the river itself for swimming is precluded by poor water quality. Many county residents swim in local lakes, but recreation is allowed in only half of the 61 existing lakes, ponds and reservoirs, and only 350 acres of water are available for public use. The Burlington County Open Space and Recreation Plan recommends that local streams be developed for swimming. Public access to inland water bodies must be improved to alleviate future demands for swimming.

Six of the ten marinas in Burlinton County are located on the Delaware River. The anticipated deficit for boating in the year 2000 of 20,300 person-days indicates that additional boat access must be provided on the Delaware. Several dredged material disposal sites exist in Burlington County, and future development of these sites for water-oriented recreation would help to satisfy the regional demand for boating. Disposal sites can also provide scenic vistas of the Delaware River. Burlington City's waterfront park currently offers an excellent vista of the river and Bristol Borough.

Camden County: Camden County, along with Burlington and Gloucester counties, comprise the New Jersey SCORP's Southwest Region. The expected deficits for boating and swimming opportunities in the region have been discussed above.

The Delaware River is largely unexploited as a recreational resource in Camden County, due to its degraded water quality. The Wharton State Forest in southeastern Camden County offers swimming, boating, and

fishing, but the forest is too distant from much of the population of the county to satisfy the existing or future demands for water-based recreation. Eighteen ponds, lakes, and reservoirs with a total of 484 water acres are available for recreational use. The Cooper River Park parallels the Cooper River through much of the urbanized area of Camden County, and provides the opportunity for boating and passive enjoyment of this stream. The City of Camden has planned a waterfront park and small boat marina opposite Penn's Landing on the Delaware. Further improvement of public access to the Delaware River waterfront would alleviate some of the demand for active and passive recreation in Camden County.

Gloucester County: The existing and future recreational needs of the Southwest Region, of which Gloucester County is a part, have been discussed above. In general, there is a regional need for swimming and boating opportunities. Expansion of any existing access areas on the Delaware River and creation of new sites would ease the increasing demands for boating. The use of dredged material disposal sites as access areas may help to satisfy future demands for recreational land. Recreational use of 27 inland ponds, lakes and reservoirs in Gloucester County helps to satisfy demand at this time.

Salem County: New Jersey's SCORP combines Salem and Cumberland counties into the Delaware Bay Region for analysis of recreational supply and demand. These counties are rural and do not generate a heavy demand for water-based recreation. A deficit of 2,500 person-days of boating is expected in the year 2000. Due to the lack of locally-generated demand, the recreational potential of the Delaware Bay shoreline remains largely untapped at present. However, the recreational facilities of the Atlantic shore are not expected to satisfy the future demand for shore recreation, and development of the boating, swimming and fishing potential of the Delaware Bay will be necessary to satisfy the spillover of demand from the counties on the Atlantic Ocean. Sport fishing in Delaware Bay has improved with water quality. Improving access to the Delaware Bay in Salem County is primarily the responsibility of the state, which presently owns extensive bay frontage.

Cumberland County: As discussed above, present demands for water-based recreation in SCORP's Delaware Bay Region fall below the existing supply. The Delaware Bay shoreline in Cumberland County remains largely undeveloped for recreation. However, sport fishing is good on the bay and complete marina facilities are available at Fortescue and upstream on the Cohansey and Maurice rivers. A total of 479 water areas at 15 inland lakes, ponds and reservoirs are now available for public and private recreational use in Cumberland County. The recreational potential of the Delaware Bay, though presently unexploited, will need to be developed in the future when Atlantic coast resorts become unable to satisfy constantly growing demands.

Cape May County: The South Shore Region of New Jersey's SCORP includes Cape May, Atlantic and portions of Burlington and Ocean counties. Each of these areas borders the Atlantic Ocean, but the Cape May County study area includes 95 acres of Delaware Bay waterfront as well.

Swimming and fishing facilities in the region will be adequate through the year 2000. The existing deficit of 6,003 person-days of boating, however, will increase to 63,878 person-days during that period. Ample water of excellent quality abounds in the region, but there is a great need for many more launching ramps and marinas. The Delaware Bay shoreline must be utilized to absorb some of the boating demand in the future. Private boating facilities are now clustered near the mouth of Dennis Creek on the Delaware Bay.

Sightseeing and camping are very important to Cape May County's economy. The extensive view of wetlands from the county's roads and the proximity to water of most campgrounds are crucial factors in maintaining the popularity of these activities. Development of boating access on the Delaware Bay shoreline could enhance the attractiveness of the area for campers and at the same time detract from the enjoyment of those desiring more passive recreation. Therefore, the provision of boating access along the Delaware Bay must be carefully planned.

New Castle County: Despite the fact that the State of Delaware's population is concentrated in New Castle County, opportunities for water-based recreation there are relatively sparse. The Delaware River is not generally used for sport fishing above Delaware City. However, many tributaries offer excellent fishing and crabbing. White perch and blue crabs are plentiful in Silver Run, Appoquinimink Creek and Blackbird Creek. Boat access is available near the mouths of these streams, and complete marina facilities exist at Wilmington, New Castle, and Delaware City. The boat launch ramp at Augustine Beach is one of the seven most heavily used ramps in the state. There has been a rapid increase in boating participation in Delaware in the past 20 years, and the trend is expected to continue. At present, most of New Castle County's needs must be met by facilities in Kent and Sussex counties. The potential use of dredged material disposal sites for boating access to the Delaware River in New Castle County should be explored in detail in the near future.

Dredged material disposal sites could also provide sites for passive enjoyment of the river which would be available to the greater Wilmington population center. At present, the historic waterfronts at New Castle and Delaware City are popular areas for passive recreation, and the Civil War fort at Fort Delaware State Park on Pea Patch Island offers a unique sightseeing experience, as it is immediately adjacent to the main shipping channel.

In the interior of New Castle County, state-owned Becks Pond and Lums Pond are heavily used for freshwater fishing and provide a total of 198 water acres for boating. Becks Pond is also used for swimming.

In general, water pollution and intensive shoreline development has detracted from the desirability of water and shore-based recreation in New Castle County. All presently existing sites in the county offering water-based recreation should be maintained. In the future, as water quality improves, dredged material disposal sites should be utilized for access to and passive enjoyment of the Delaware River.

Kent County: The shoreline of Kent County is basically unattractive to swimmers because the bottom is muddy, the water turbid, and biting flies and mosquitos numerous. The coast is primarily marshy and much of it is preserved for wildlife. Sport fishing and boating, however, are very popular on the Delaware Bay and tributaries. Boat access is available along several streams, and the boat launching ramps at Woodland Beach and Bowers Beach are among the most heavily used ramps in the state. Most tidal streams in Kent County offer excellent crabbing and fishing for white perch, brown bullhead, catfish, striped bass and eels. The Mahon River is known for its sea trout and crabs, the Murderkill for white perch, the St. Jones for striped bass and the Mispillion for crabs.

In Kent County, there are 29,000 acres of public parks and open space located on the Delaware Bay shore. Over half of that area is included in Bombay Hook National Wildlife Refuge, where sightseeing and nature study are the primary activities. The only state wildlife area on the Delaware Bay where fishing and boating are allowed is the Woodland Beach Wildlife Refuge. Numerous state parks and recreation facilities on inland ponds, however, offer excellent fishing, boating and swimming. The largest of these areas is Killen Pond State Park, over 500 acres in size, but a total of almost 400 additional water acres are available to the public for inland boating and fishing.

The inland ponds satisfy a large portion of the county's demand for water-based recreation. Facilities for coastal fishing and boating, however, need to be expanded. The Mahon and St. Jones rivers have been identified as having exceptional potential for development as boating and fishing centers. Perhaps dredged material disposal sites in the vicinity of these streams will prove suitable for the development of boat launching facilities.

Sussex County: Sussex County is the prime area for shore-based recreation in Delaware. The beaches of the Atlantic coast are the county's biggest recreational asset, followed by Rehoboth, Indian River and Asssawoman bays. The best recreational frontage on the Delaware Bay in the State of Delaware lies between Slaughter Beach and Lewes, in

Sussex County. Boating is one of the most popular activities in the county, and major marina centers are located at Lewes and on Indian River. The boat launching ramps at Milton on the Broadkill River, Lewes on the Lewes-Rehoboth Canal, and in the vicinity of Indian River Bay and Rehoboth Bay are among the busiest in the state.

Several important coastal state parks are located in Sussex County. Cape Henlopen State Park, at the junction of Delaware Bay and the Atlantic Ocean, is a beach-oriented park of regional significance. Delaware Seashore State Park extends from Dewey Beach to the Maryland border, and includes Indian River Inlet. The park's beaches and proximity to Rehoboth and Indian River bays make this a heavily used vacation spot. Holt's Landing State Park also provides public access to the inland bays.

Indian River and Rehoboth bays are extensively used for boating and fishing. Over 180,000 person-days per year of boating occur on the bays, as well as over 200,000 person-days of fishing. Winter flounder, bluefish, striped bass and summer flounder are some of the most plentiful sport fish. Crabs are also abundant in the late summer in the bays.

Sightseeing is another popular waterfront activity in Sussex County. Primehook National Wildlife Refuge, the town of Lewes, the Rehoboth Beach boardwalk and Fenwick Island lighthouse are popular sites for passive recreation.

The demand for water-based recreation in Sussex County generated by Delaware residents and out-of-state visitors is expected to increase in the future. Residential development in the vicinity of Indian River and Rehoboth bays is rapidly increasing and placing a greater strain on facilities already being used at full capacity. Heightened public interest in boating on the Delaware Bay is also anticipated, though relatively few access facilities exist along Sussex County's Delaware Bay waterfront. The use of dredged material to create access areas is infeasible along much of the shoreline because of the valuable wetlands growing there. Efforts to provide access to the bay should be concentrated on segments of the shoreline which have already been filled.

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CONCLUSION

The natural features of the Delaware Estuary and adjacent counties have been inventoried, and the impacts of dredging and disposal of dredged material were discussed. The potential impacts of dredging and disposal activities on the resources of each county are summarized in Table 10. The table also addresses the potential of natural features to impact dredging and disposal activities. Both positive and negative impacts are included, and are briefly explained in the final column of the table. In those cases where a natural feature may affect, or be affected by dredging and disposal, the significance of the impact has been ranked.

The table indicates that wetlands and groundwater are two natural resources which may be severely impacted by dredging and/or disposal of dredged material. Groundwater quality in some counties is more likely to be affected by disposal than in others, though the consequences are equally as important in all counties. Wetlands may be severely disturbed by dredging and disposal. Some shoreline soils in all counties pose constraints on disposal of dredged material, but testing would be necessary to determine the severity of the limitations. Surface water can be affected by turbidity and heavy metals from dredging operations, though the magnitude of the impact decreases as the distance from the dredging site increases. The potential impacts of dredging and dredged material disposal on recreation are both positive and negative. Turbidity from dredging operations may temporarily affect existing recreation sites in some counties. However, waterfront recreation land is so sparse in the same counties that dredged material disposal may prove to be beneficial if the sites are made available for recreational use. It may be necessary to wait several years after deposition of dredged material before a site is sufficiently stable to permit its use for recreation.

TABLE 10

POTENTIAL IMPACTS OF DREDGING AND DISPOSAL ACTIVITIES ON NATURAL FEATURES(1)

County	Feature(2)							
	Climate	Physiography	Soils	Surface Water	Groundwater	Wetlands	Vegetation	Recreation
Bucks	3	4	2	2	1	1	3	2
Philadelphia	3	4	2	2	1	1	3	2
Delaware	3	4	2	2	2	1	3	2
Mercer	3	4	2	2	2	1	3	2
Burlington	3	4	2	2	2	1	3	2
Camden	3	4	2	2	1	1	3	2
Gloucester	3	4	2	2	2	1	3	2
Salem	3	4	2	2	1	1	4	4
Cumberland	3	4	2	3	1	1	4	4
Cape May	3	4	2	3	1	1	4	4
New Castle	3	4	2	2	1	1	4	4
Kent	3	4	2	3	1	1	4	4
Sussex	3	4	2	2	1	1	4	4

(1) Impacts are rated by significance as follows:

1 = Likely to be very severe, and negative
2 = Positive and negative impacts moderately significant, probability of occurrence low
3 = Positive and negative impacts minimally significant, probability of occurrence low
4 = No significant impact foreseen

(2) Nature of Impact

Climate:	Occasional storms may temporarily impact dredging activities
Physiography:	Steep slopes may limit availability of disposal sites; site studies needed
Soils:	Soils must be tested to identify constraints; many limitations can be corrected
Surface Water:	Turbidity and heavy metals may impact streams very close to dredging and disposal sites
Groundwater:	Kirkwood-Cohansey and Pleistocene deposits very vulnerable to spoil deposition; overpumped areas of Magothy-Raritan vulnerable
Wetlands:	All wetlands negatively impacted by dredged material disposal, dredging of wetlands and dredging of sites immediately adjacent
Vegetation:	Disposal activities not likely to impact non-wetlands vegetation; few remaining natural areas in urban counties should be protected
Recreation:	Use of dredged material disposal sites for recreation can help satisfy demands in these counties; turbidity temporarily impacts existing recreation

SECTION C-2

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

1825B Virginia Street
Annapolis, MD 21401

April 25, 1979

District Engineer
Philadelphia District, Corps of Engineers
Custom House, 2nd & Chestnut Streets
Philadelphia, PA 19106

Dear Sir:

Enclosed is a planning aid report furnished under terms of the Scope of Work Agreement for 1979 to assist in the Delaware River Dredge Disposal Study. This report includes the requested analysis for Delaware's Atlantic coastal bays which were added to the study area last year.

This report provides fish and wildlife resource data for Delaware's Atlantic coastal bays, identifies areas critical or sensitive to the dredged disposal problem, and augments the general impacts assessment of dredged disposal on fish and wildlife which has previously been submitted.

If you have any questions concerning the report, please do not hesitate to contact us.

Sincerely yours,

Glenn Kinser

Glenn Kinser
Supervisor
Annapolis Field Office

Enclosure

PLANNING AID REPORT ON

DELAWARE'S ATLANTIC COASTAL BAYS

PREPARED FOR:

DELAWARE RIVER DREDGING SPOIL
DISPOSAL STUDY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS

PREPARED BY:

U. S. FISH AND WILDLIFE SERVICE
ANNAPOLIS, MD 21401

APRIL 1979

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I. INTRODUCTION

This planning aid report is furnished to the Philadelphia District, Corps of Engineers, under terms of the Scope of Work Agreement for 1979, to assist the District in preparation of the Delaware River Dredging Spoil Disposal Study. It is submitted pursuant to the provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

This report includes a brief account of fish and wildlife resources in the study area, identification of areas critical or sensitive to the disposal problem, and augments the general impact assessment of dredged material disposal on fish and wildlife previously provided by the Service.

The geographical scope of this report includes Delaware's Atlantic Coastal Bays and their tributaries. The study was expanded in 1978 to include this region as well as the Delaware River proper. The study area addressed in this report is comprised of Delaware's Atlantic coastal bays including Rehoboth, Indian River, and Little Assawoman Bays. Figure 1 depicts the general study area which lies wholly within Sussex County, Delaware.

II. GENERAL ECOLOGY OF DELAWARE'S ATLANTIC COASTAL BAYS

The Atlantic coastal bays are characterized by a series of barrier dunes and beaches protecting the back bays and their wetland areas. The major back bays Rehoboth, Indian River, and Assawoman Bays. The bays are set in the Atlantic Coastal plain of southeastern Delaware.

Rehoboth Bay, generall, is more shallow and exhibits poorer flusing characteristics than Indian River Bay. Love, Herring, and Guinea Creeks are the major tributaries to Rehoboth Bay. Indian River, Pepper, and White Creeks are the major tributaries to Indian River Bay. Little Assawoman Bay has three major tributaries, Assawoman Canal-Jefferson Creek, Miller and Derickson Creeks. The western shore of the bay is included in the Assawoman Wildlife Area and remains largely undeveloped (Martin, 1974). These tributaries are shown in Figure 2. Three distinct estuarine systems are formed by Rehoboth, Indian River, and Little Assawoman Bays. Indian River Bay developed as a drowned river valley while Rehoboth and Little Assawoman Bays are bar-built estuaries (Jenson, et. al., 1976). In general, water depths vary from one to fifteen feet and average six to eight feet. Tidal amplitude varies from about 4 feet at Indian River Inlet to less than 1 foot in the upper reaches of some of the tributaries.

Salinity varies from sea water at Indian River Inlet to nearly fresh at the headwaters of the tributaries. Vertical stratification generally is not a problem in these shallow bays. However, severe and rapid local changes in water quality parameters do occur. Even though fresh water inflow is relatively low and varies seasonally, the shallow nature of the estuaries coupled with wind and tide generated currents produces a region which can exhibit sharp and changing salinity patterns. Sudden cold snaps, heavy rains, storms, hot spells, and strong winds may have a significant effect on distribution of flora and fauna within the systems (U. S. Army Corps of Engineers, 1977).

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Ecological characteristics of each bay are quite varied reflecting th gradients of physical conditions present and the tidal and seasonal cycling of the environment. Man has effected considerable alteration on the estuarine systems in the past 100 years. The most apparent al ation has been the permanent opening of the once dynamic Indian River Inlet. Prior to 1937, the inlet was a shallow, frequently closed san displaying typical washover and cuts characteristic of Atlantic barri (Delmarva Power and Light Company, 1976). All the bays have experien extensive residential development in recent years which has resulted significant destruction of wetlands and natural shorelines. Less dra though no less significant, alterations have been accomplished throug heavy recreational development since about 1945 and accompanying land changes (Jenson, et. al., 1976).

In considering the evolutionary principals of ecology, there is no re to believe that the biota of Delaware's Atlantic coastal bays have fu adapted to the rapid changes which have been inflicted upon the bays past 100 years. Rather, they are more likely in a state of transitio along an evolutionary continuim which is hidden from us save for a br glimpse at the present. The significance of this perspective lies in cognizing that the ecosystem is a dynamic, ever-changing complex whic reacts, to some degree, to every external and internal action applied

III. FISH AND WILDLIFE RESOURCES

The components of the fish and wildlife resource data will be examine in the following catagories: wetlands, aquatic vegetation, shellfish finfish, plankton, benthic invertebrates, wildlife and threatened and endangered species.

A. FISH AND WILDLIFE RESOURCES - WETLANDS

The wetland resources in Rehoboth, Indian River, and Little Assawoman Bays are composed of extensive fringe marsh along the shoreline as well as more extensive saltmarshes. Total wetland area is 2,661 hectares (6,573 acres). Of this, approximately 95% (2,531 hectares) is cordgrass marsh and 5% (130 hectares) is salt bush-salt meadow marsh. These values are not precise and do not account for transition areas and species diversity within a dominant type marsh. The area has lost about 843 hectares (2,082 acres) of wetlands since 1938, a reduction of 20% (Delaware Coastal Zone Management Program, 1976).

These wetlands have been classified with respect to value for recreation, wildlife habitat, spawning and nursery area, primary productivity, hunting and trapping potential, pest generative potential, flood buffer/erosion control, physiographic value, historical value, development potential, sediment trapping and other relevant factors (Delaware Coastal Zone Management Program, 1976). This ranking process evaluated the wetlands areas in the Rehoboth, Indian River and Little Assawoman Bay areas in relation to all of Delaware's wetlands.

A high value was assigned for primary production, hunting, avian habitat, and washover and flood protection. Relatively high value was assigned for spawning and nursery areas, recreation and potential industrial/commerical/ residential development. An extremely high degree of manipulation of the system, including a tremendous wetland loss, is evident. Thompson's Island has demonstrated archaeological values.

The Assawoman Wildlife Area is an extremely valuable mammal and bird area and supports some insect control research work. The wetland areas as a whole are of high quality to birds, particularly ospreys, mute swans, brants, canada geese, and many ducks. Several wetland areas support nesting ospreys and occasional bald eagle nests. Three areas, Poplar Thicket, Blackwater Creek Marsh and False Cape are state natural areas.

The many benefits which are derived from wetlands have been recognized through state and federal legislation and policy changes over the years. Wetland areas should be preserved and enhanced wherever possible.

B. FISH AND WILDLIFE RESOURCES - SUBMERGED AQUATIC VEGETATION

We are unaware of any efforts to map the submerged aquatic vegetation in the study area. Submerged grass beds have very high value as food for waterfowl and as shelter and feeding areas for fish. It is likely that these shallow estuaries do support substantial beds of submerged aquatic vegetation. Every effort should be made to avoid these areas in any dredge or fill operation. Identification of submerged aquatic vegetation beds should be undertaken during the planning of any area-wide dredging oe disposal project.

C. FISH AND WILDLIFE RESOURCES - SHELLFISH

The hard clam (*Mercenaria mercenaria*) is the most important commercial shellfish resource in Rehoboth, Indian River, and Little Assawoman Bays. Virtually all of the commercial hard clam landings reported for Delaware have come from Indian River and Rehoboth Bays.

Commercial landing figures compiled by the National Marine Fisheries Service (Table 1) for the past ten years have shown a declining overall harvest of hard clams during the past seven years. Statistical analysis of this data by personnel of the Division of Fish and Wildlife, Delaware Department of Natural Resource and Environmental Control indicates that a decline in hard clam populations in Indian River Bay is apparent. It is probably due to (1) heavy commercial fishing pressure in Indian River Bay during the late 1960's and early 1970's; and (2) the lack of optimum sediment types (oyster shell or sand mud) to support and protect high densities (Cole, 1977).

A survey of hard clam densities was performed by Delaware to gain baseline data to aid in formulation of a hard clam management plan. Figures 3 and 4 indicate the distribution of hard clams in Rehoboth and Indian River Bays.

Most of the commercial oyster (Crossostrea virginica) landings in Delaware come from Delaware Bay. Delaware does lease some oyster bottom in Indian River off Blackwater Creek. Last year only one commercial oyster fisherman worked the area. He reported planting 1200 bushels of seed oyster during 1978 (Cole, 1979). Commercial oyster landings in Indian River Bay have steadily declined in recent years. Figure 5 shows existing charted oyster bottom in Indian River Bay.

Blue crabs (Callinectes sapidus) provide a substantial recreational fishery in the three coastal bays. There is no commercial crabbing in Rehoboth or Indian River Bays. Lobster are occasionally taken off the jetties at Indian River Inlet.

The commercial shellfish harvest, both in pounds and dollar value, has consistently been greater than the finfish harvest in Delaware, and contributes substantially to Delaware's economy. However, there has been an overall decline in recent years in shellfish harvest (Table 2).

D. FISH AND WILDLIFE RESOURCES - FINFISH

The importance of Indian River Bay as a nursery area for significant commercial marine species such as menhaden has been documented (Pacheco, 1975). A description of the ocean fishery off Delaware Bay may be found in Reintjes and Reithmayr (1960). Listings of resident and migrating finfish in Indian River Bay may be found in the previously referenced environmental impact statements and Campbell (1975). The Bays continue to support a substantial commercial and sport fishery. Martin (1974) indicates that Little Assawoman Bay is an important nursery area for many species including summer flounder, spot, menhaden, eel, sea trout, white mullet and Atlantic herring.

Historically, Indian River Bay has been the site of heavy spawning concentrations of winter flounder (*Pseudopleuronectes americanus*). Spawning begins in late January and continues through mid-March. In the past six years spawning has been depressed in Indian River Bay presumably resulting from reduced stock (Miller, 1979). Indian River Bay is considered to be the southern extent of the winter flounder's range.

The contribution of sport and commercial fishing to Delaware's economy is significant. Table 2 shows the commercial finfish landings in terms of

pounds and dollar value from 1972 to 1977. Delaware's Atlantic coastal bays do not directly provide a large part of the Delaware commercial landing of finfish. However, they are very important as spawning and nursery grounds for these fish.

Miller (1978) evaluated marine recreational fishing in Delaware. Table 3 indicates the recreational fishing pressure in man-days applied to Delaware waters. Table 4 indicates the approximate contribution of Rehoboth, Indian River, and Little Assawoman Bays to fishing pressure in Delaware. These areas provide virtually all (90%) recreational clamming and a large part of the fishing (35%) and crabbing (46%) opportunities in Delaware. Based on these data, the Atlantic Coastal Bays provide about 210,000 man-days of small boating, 75,000 man-days of recreational clamming, and 28,000 man-days of recreational crabbing.

E. FISH AND WILDLIFE RESOURCES - PLANKTON

The micropelagic members of the aquatic community are not often treated in traditional fish and wildlife resource documents. However, because of the intricate relationships of the planktonic community to more complex organisms through energy and nutrient cycles and the dependency of the macrobiota on the microbiota, this report will briefly describe the general community structure of the study area.

Delmarva Power and Light Company (1976) has published a recent comprehensive study of plankton in Indian River in the vicinity of the Indian River Power Station.

Thirty-six phytoplankton species were found to contribute the majority of algal biomass. Diatoms were dominant, followed by dinoflagellates. Green and blue-green algal distributions have been restricted generally to headwaters of the estuaries. The generally lower number of total taxa found in Indian River has been attributed to the compact nature of the estuary and the steep, rapidly changing salinity gradients which occur there. Spatial and temporal distribution patterns, biomass production and community nutrients are addressed in the Delmarva report. Biological indicators show that the upper estuary is noticeably enriched in summer months creating adverse biological conditions.

A discussion of zooplankton taxa found in Indian River including their productivity and distribution, is also contained in Delmarva Power and Light Company (1976). Apparently the estuary possesses relatively good species diversity and abundance.

F. FISH AND WILDLIFE RESOURCES - BENTHIC INVERTEBRATES

A listing of benthic invertebrates (excepting commercial shellfish) found in Indian River is present in U. S. Army Corps of Engineers (1977) and Delmarva Power and Light Company (1976). The latter contains a discussion of standing crop, distribution and dominance. These data will not be reiterated here.

G. FISH AND WILDLIFE RESOURCES - WILDLIFE

The three coastal bays have very high value for wildlife. Assawoman Wildlife Area provides a protected wildlife area.

Annual waterfowl census data (Whittendale, 1978) indicate that the three bays are used by a variety of migratory waterfowl. Listings of migratory and resident avians are found in U. S. Army Corps of Engineers (1977) and Delmarva Power and Light (1976). There has been a decline in gull and tern nesting habitat in recent years resulting from erosion of several small islands in Rehoboth and Indian River Bays. Several bald eagle nests are observed each year in southern Delaware. These nesting sites are not consistently active from year to year and prediction of bald eagle acitivity is difficult.

Mammal, reptile, and amphibian species present in the area are listed in U. S. Army Corps of Engineers (1977) and Delmarva Power and Light Company (1976). Many species are directly dependent on the estuaries, adjacent wetland areas and the remaining undeveloped shoreline area.

The water/land interface along the coastal shorelines is a critical zone to area wildlife. This ecotone supports the nutrient and energy transfers between the two systems. Table 5, taken from Jenson (1976), depicts the alterations which have occurred to the area shoreline in the past 40 years. Indian River Bay has lost almost half (44%) of its natural shoreline to development. This has undoubtedly stressed the wildlife communities of the area.

H. FISH AND WILDLIFE RESOURCES - THREATENED AND ENDANGERED SPECIES)

A list of threatened and endangered species is found in Table 6. Any of these species may be found in the study area. Peregrine falcons (*Falco peregrinus*) transit the coastline during annual migrations. The bog turtle (*Clemmys muhlenbergi*) is normally restricted to the piedmont area of Delaware

and is rarely found in the southern part of the state (Arndt, 1978). The range of the Delmarva fox squirrel (Sciurus niger cinereus), an endangered species, is presently thought to be confined to portions of the Delmarva Peninsula in Maryland and Virginia. The Ipswich sparrow (Passercylus sandwichensis princeps), a species of relative rarity, winters along the Atlantic coastal beaches and dunes. It is not currently classified as either rare or endangered.

Of primary concern, is the bald eagle, Haliaeetus leucocephalus. Throughout the 1970's from one to four active nest have been identified each year. The 1978 Chesapeake Bay Bald Eagle Nest Survey reported three abandoned nests for Delaware, one located on the north shore of Indian River (Abbott, 1978). Another nest has been reported in the vicinity of Love Creek, a tributary of Rehoboth Bay (U.S. Department of Agriculture, 1978).

This report does not satisfy consultation requirements of Section 7 of the Endangered Species Act.

IV. AREAS CRITICAL OR SENSITIVE TO DREDGED DISPOSAL PROBLEMS

The following list represents some types of areas that are of critical concern to fish and wildlife resources from the perspective of dredged disposal problems. The list is by no means comprehensive or complete and should not be interpreted as the only areas of concern. They are not necessarily listed in order of priority.

A. Submerged aquatic vegetation beds. These areas should be avoided in dredged or disposal operations because of their high food and cover value to fish and wildlife.

B. Spawning areas/seasons. Dredging and disposal activities should be avoided in shellfish or finfish spawning area especially during spawning periods.

C. Nursery areas for fish should be avoided during seasons in which dredging or disposal operations could affect juvenile fish.

D. Shellfish beds. Shellfish beds should be avoided entirely during dredging and disposal operations. This would preclude impacts resulting from a sediment deposition, turbidity, or degraded water quality.

E. Highly productive benthic communities. Such communities are vital to organisms higher on the food chain and should be avoided. Recolonization of such areas after a dredge-related disturbance rarely supports the species diversity which existed prior to disturbance.

F. Threatened or endangered species. Direct impacts as well as indirect impacts may result from navigation project. Feeding, resting or breeding areas for any threatened or endangered species should be avoided.

G. Water/land interface. The water/land interface (shoreline) should be protected from extreme alteration (such as bulkheading or vegetation

removal) because of its value for terrestrial/aquatic transfers of nutrients, energy, and organisms.

H. Wetlands. Disturbance of wetland areas should be avoided because of the many benefits provided by such areas.

V. GENERAL IMPACT ASSESSMENT OF DREDGED MATERIAL DISPOSAL ON FISH AND WILDLIFE

A great deal of research has been conducted in the past ten years by State and Federal development and regulatory agencies. The most intensive research effort has been the Corps of Engineers' Dredged Material Research Program (DMRP) carried out by the Waterways Experiment Station, Vicksburg, Mississippi. The DMRP is currently coming to an end. The U. S. Fish and Wildlife Service (Morton, 1978) has published a brief summary of ecological effects of dredging and filling. The remainder of this report will rely heavily on Morton (1977).

In spite of the substantial effort which has been expended in research on dredge and fill problems, much remains to be learned concerning the effects of such operations. In particular, synergistic, sub-lethal effects are poorly understood. It is necessary, therefore, to proceed on the conservative side of impact analysis thus avoiding the assumption that if ill-effects have not been demonstrated in a particular situation, no-ill effects exist.

Dredging and disposal effects can be divided broadly into three catagories, each defined by the pathway or mechanism in which effects are mediated.

For the purpose of this discussion, effects will be addressed as physical chemical, or biological in nature. This discussion is very general and broad. Reference should be made to other sources for more detailed information.

A. PHYSICAL EFFECTS

Dredging and disposal of dredged material basically constitutes a process of artificially induced sediment erosion, transport and deposition. The process differs from the natural one in being much more concentrated in space and time. The physical effects of dredging and disposal on the estuaries environment can be summarized briefly as follows: temporary increases in turbidity at both dredge and disposal sites; changes in bottom topography with resulting changes in water circulation patterns; and, changes in the mechanical properties of the sediments at the dredge and disposal site.

The relative significance of these effects on a given estuarine system is a function of the ratio of the dredged area to the total bottom area and contained water volume. Reduced inlet size and long flushing periods for bays magnify the hydrologic effects of dredging projects. Other important factors influencing the physical impact of dredging and disposal are type and volume of sediment, dredging frequency, climatic conditions, and methods employed.

Increased turbidity results in reduced light penetration, reduced photosynthesis, and altered heat radiation patterns. Changes in bottom topography and circulation patterns may be much more signficant than turbidity plumes. Circu-

lation changes may result in shifts in salinity, salt wedge movement, sediment transport patterns, erosion, acretion, and attendant impacts such as altered flushing rates and water quality problems. The mechanical properties of sediments, such as grain size, and porosity, can be altered by moving material. The suspension and resuspension of sediment, especially in hydraulic dredging, may change the physical character of the substrate in both the dredged area and the disposal area. These changes may in turn affect the processes controlling the flows of pollutants across the sediment-water interface and the stribution of benthic organisms. Of particular concern, is the production of fluid mud or mud flow often occurring in dredging operation in high silt/clay sediment types. Concentrations of suspended sediments exceeding 10 grams per liter have been shown to generate fluid mud.

The long-term fate of dredged material in unconfined disposal areas is not well studied in most dredging projects. Sediment transport away from the disposal site may be caused by wind or tide generated currents and may affect benthic organisms and continued maintenance of the navigational channel. Apparently three prime factors, grain size, degree of consolidation of bottom sediment and current characteristics control post-dredging sediment transport.

B CHEMICAL EFFECTS

Dreding and spoil disposal are likely to produce changes in the chemistry of the water overlying the dredging and disposal sites for two reasons. First, undisturbed estuarine sediments typically exhibit a gradient from oxidized

surface deposits to increasingly reduced sediments in the deeper layers; the deeper, reduced sediments create an oxygen demand when they are exposed to the aerobic environment of the overlying water body and become oxidized. Second, it is generally assumed that the chemical constituents associated with the surface sediments are in dynamic equilibrium with the overlying water, whereas those associated with the deeper sediments are not. As the deeper sediments are mixed with water during dredging and disposal, the potential for remobilization of their chemical constituents increases.

Dissolved oxygen depletion and release of nutrients and contaminants are chemical changes often associated with dredging and disposal operations. The complexity of possible chemical reactions that occur during resuspension of sediments makes prediction of effects very difficult and highly variable from site to site.

Dissolved oxygen (DO) concentrations in the vicinities of the dredging and disposal sites have an important effect on the chemical form, solubility, and mobility of chemical constituents of the dredge spoil. If the potentials for release of plant nutrients, heavy metals, pesticides, and other organic compounds are to be assessed, one must estimate the oxygen demand resulting from dredging and spoil disposal. Dredging and spoil disposal often caused at least temporary reductions in DO concentrations in the water columns overlying dredging and disposal sites and may cause persistent DO changes.

Changes in dissolved oxygen concentrations may effect the dredged or filled area by: (1) the stimulation or inhibition of primary production, (2) changes in physical arrangement of the sediment (deposited to suspended); (3) redox potential of the sediment; (4) the magnitude of the organic fraction in the sediment; (5) chemical composition of the sediment; (6) how the sediments are handled during dredging and disposal; and, (7) degree of flushing that occurs at the dredging and disposal sites.

Concentrations of organic compounds, nutrients (primarily phosphorous and nitrogen) and other contaminants (heavy metals, trace metals) are often altered by disruption or sediments during dredging because of the relationship of these substances to sediment.

Organics sorb to fine particulate matter and later settle out of the water column with the particulate matter. This organic-particulate matter association is influenced by the type of functional groups present, surface area of the particle, the molecular weight of the organic matter, salinity, pH, and temperature. The amount of organic matter may increase 100,000 times its dissolved value when adsorbed to fine inorganic particles or muds.

The processes by which heavy metals, plant nutrients, pesticides, and trace elements transfer across the sediment-water interface are complex and not yet fully understood. However, several factors have been identified that seem to play important roles in these processes: the clay content, organic fraction, redox potential, and pH of the sediment; the species of bacteria present; and the sulfur and iron cycles.

C. BIOLOGICAL EFFECTS

The biological effects of dredging and spoil disposal on fish and wildlife are mediated through the environment by the physical and chemical alterations previously addressed. This is the least understood of the three catagories. In most cases, current understanding of these effects is too limited to allow predicting with any assurance whether dredging or disposal will contaminate a man-ended food chain, eliminate an endangered species, or have undesirable irreversable impacts on a biological community. The magnitude of all biological effects is influenced by the biological cycles in which the affected organisms participate. Therefore, analysis of biological effects cannot be complete without considering the seasonal physiological changes of the species in question.

Gross biological effects include total destruction of benthic communities in areas dredged or filled. Recolonization may be almost complete or absent altogether and may take months or years to achieve. Maintenance dredging introduces the problem of periodic disruption of the aquatic system which may permanently preclude recolonization. General, species diversity is somewhat reduced in a recolonized area when compared with a natural area. The rate of recolonization is affected primarily by changes in the physical and chemical properties of the sediment and changes in water depth and circulation patterns.

Turbidity generated by dredging and disposal has a wide range of biological effects. These include smothering of benthic organisms, interference with digestive and metabolic processes, interference with the rate of water transport and efficiency of filtering mechanisms in filter feeders, dis-

ruption of organismal energy budgets, interference with reproductive capacity, clogging of gill epithelial tissue in fish, reduction of primary productivity, and shifts in existing food chain relations. Two general observations are that: (1) bottom dwelling fish are most tolerant and filter feeding fish least tolerant to high turbidity levels and, (2) juvenile forms are more sensitive than adults.

Turbidity effects are determined by the size, shape, and chemistry of suspended material, duration of exposure, and physiological and developmental state of the affected organisms.

Alterations in hydrologic and circulation patterns may permanently alter a biological community. Dredging may remove a bottom from the euphotic zone, thus altering productivity. Conversely, shallow water deposition may raise a bottom into the euphotic zone or intertidal zone. Circulation patterns in estuaries influence salinity and nutrient gradients. Plankton movement including plants, animals, and larval and juvenile forms of higher organisms, is dominated by water currents. Changes in tidal pattern, circulation and flushing rates can affect the distribution, size, and species composition of plankton. In some cases, these changes could result in significant food chain or community structure alterations.

Changes in sediment characteristics such as grain size can alter the composition of the entire biological community. Successful population of shellfish require specific bottom types, especially in commercially valuable concentrations. Fish reproductive success oftens depends on the availability

of suitable substrate for attachment of demersal eggs and nest building. Disruption of a large area of substrate, particularly in a spawning area, could be damaging to a population.

Biological effects of dredging may be expressed through water chemistry pathways. Low dissolved oxygen concentrations are stressful on all oxygen dependent species. The presence of high concentrations of nutrients may stimulate excessive phytoplankton growth to a point that oxygen consumption through respiration exceeds photosynthetic oxygen production resulting in depletion of dissolved oxygen. The situation is aggrevated by the oxygen demand created by decoying vegetation.

Resuspension of sediment may release pollutants into the water column thereby affecting aquatic life. A wide array of biological effects result from high concentration of heavy metals, organic compounds, and other pollutants. Detailed analysis of contaminated sediments is necessary prior to formulating a plan for dredging and disposal of such sediments. Bioassays and elutriate testing are standard analytical tools. Possible synergistic effects should be evaluated as thoroughly as possible keeping in mind the complex nature of chemical reactions which may occur.

Non-lethal biological effects are very difficult to define and study. Long-term chronic effects may gradually depress a population or community structure without definition of a clear cause-effect relationship. All the dredging and disposal impacts outlined above may be expressed in the environment at concentrated lethal levels or at less concentrated sub-lethal levels.

Polluted sediments pose an especially difficult task when attempting to predict the impacts of dredging and filling.

In summary, we have learned much regarding the effects of dredging and filling in recent years. At the same time, we are learning how much remains to be studied. Although direct burial and habitat destruction (e.g., a change in the physical and chemical character of the bottom sediments) are the two most obvious effects of dredging and spoiling on biological communities, these effects can be minimized by careful timing of the dredging and placement of the spoils. Exposure to toxic contaminants sorbed to sediments cause a variety of physiological and behavioral disorders in estuarine biota. Understanding of how various organisms are affected by different doses of a contaminant is limited because of the complexity of the processes controlling the remobilization and uptake of the various contaminants and because of the variability in response between species and between different life stages of the same species.

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APPENDIX

FIGURES AND TABLES

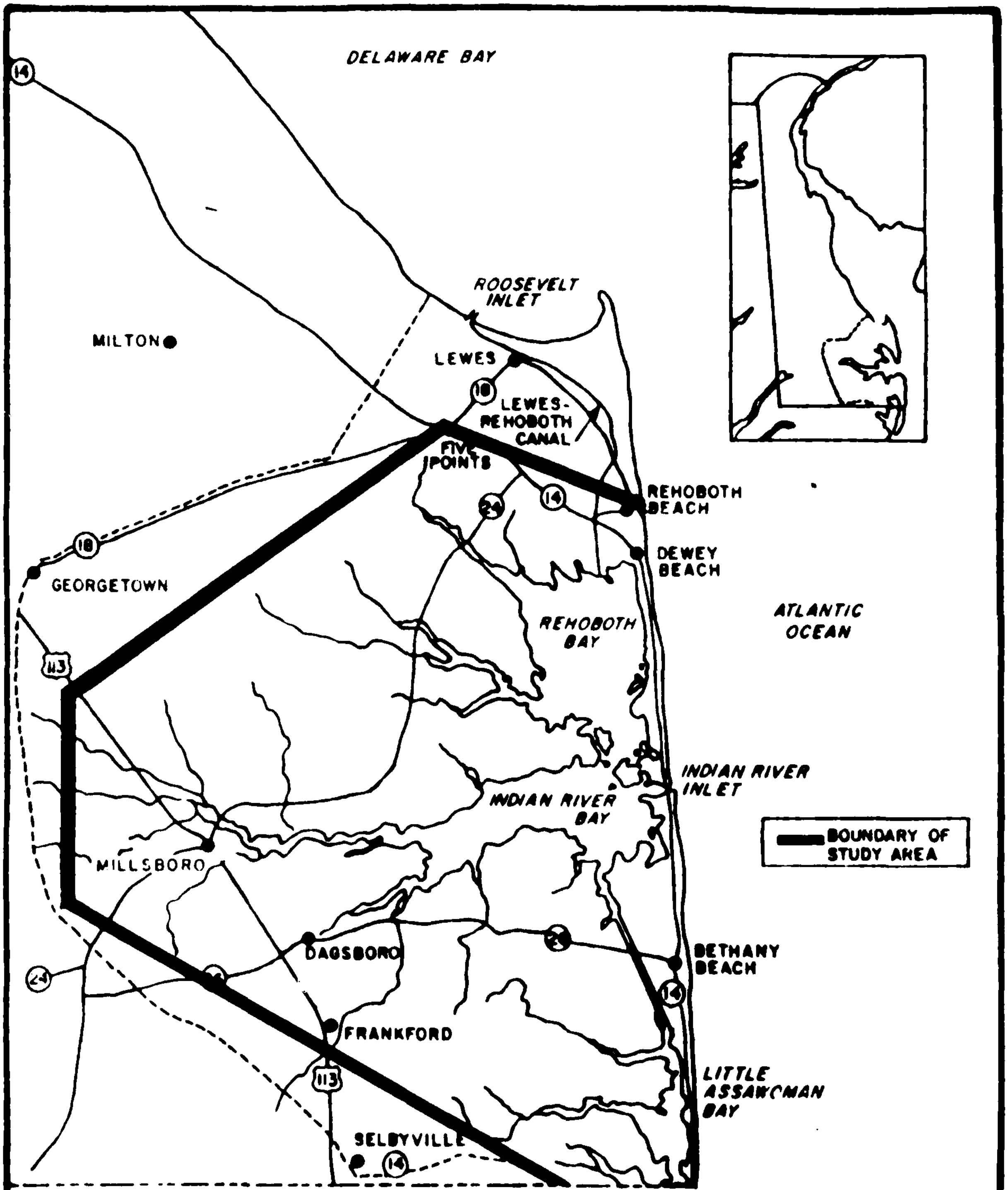


Figure 1 Map of Study Area

Tidal Streams in Study Area

15. Love Creek
16. Herring Creek
17. Guinea Creek
18. Indian River
19. Pepper Creek
20. White Creek
21. Assawoman Canal
22. Miller Creek
23. Dirickson Creek

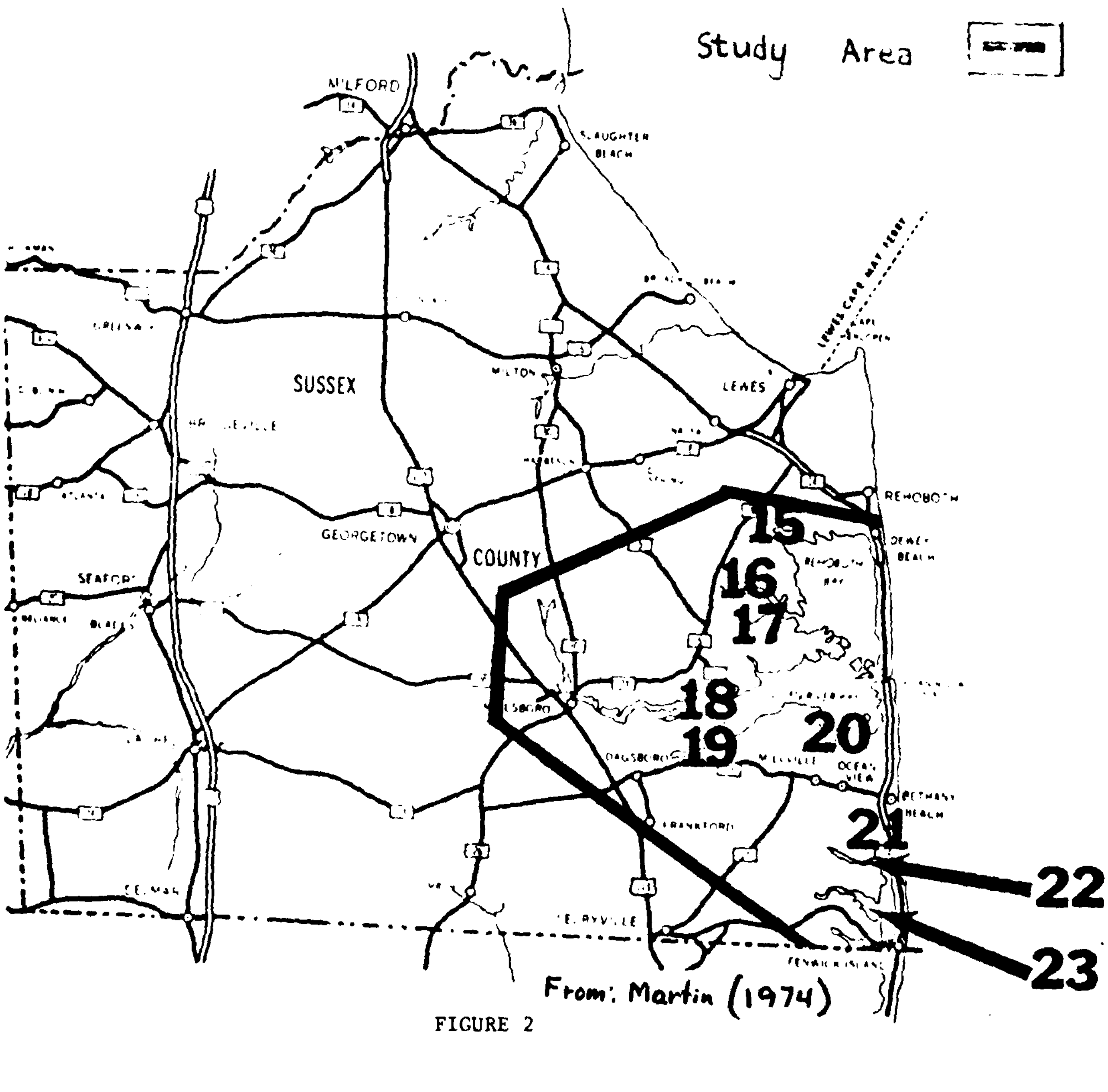
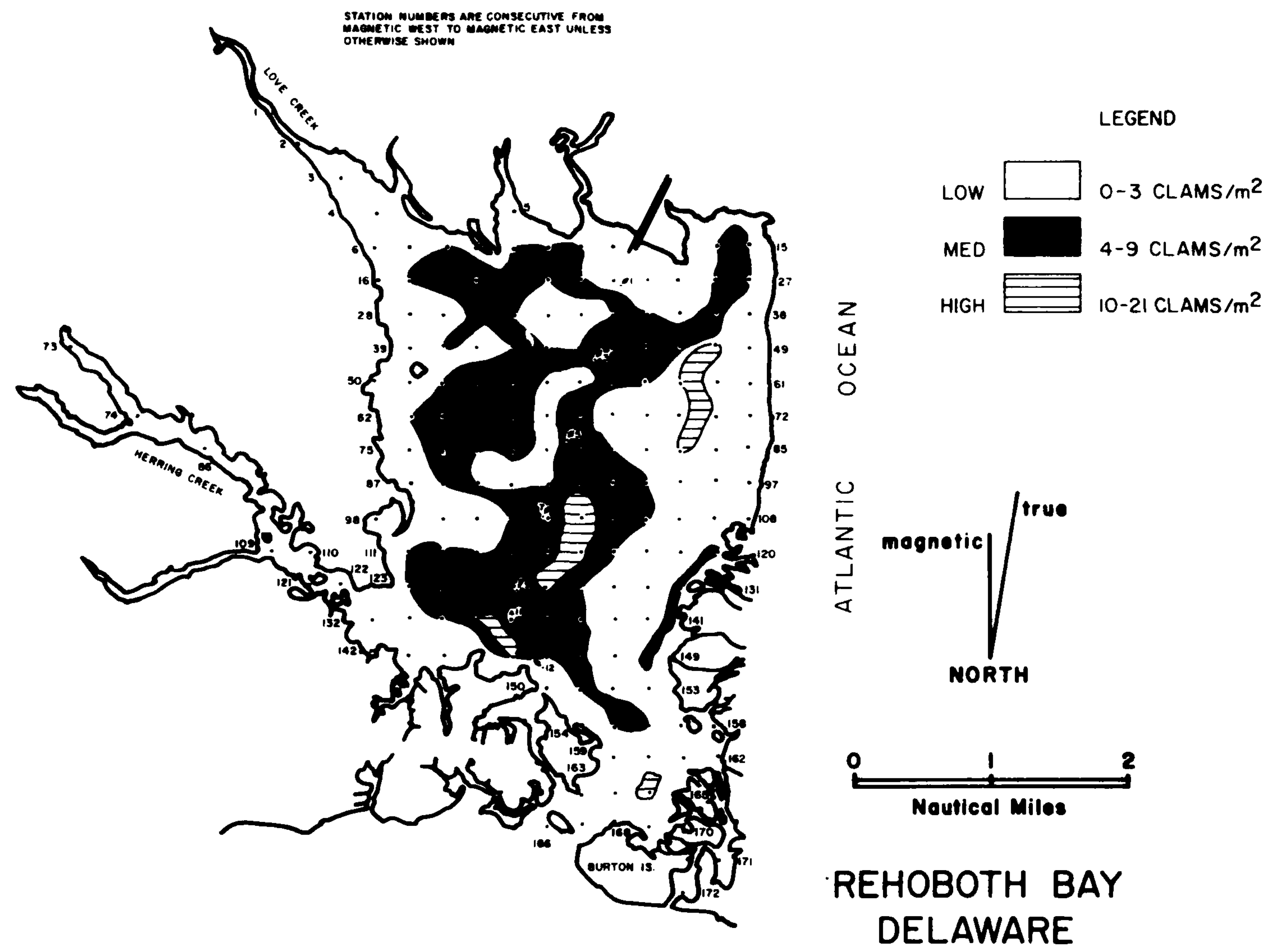
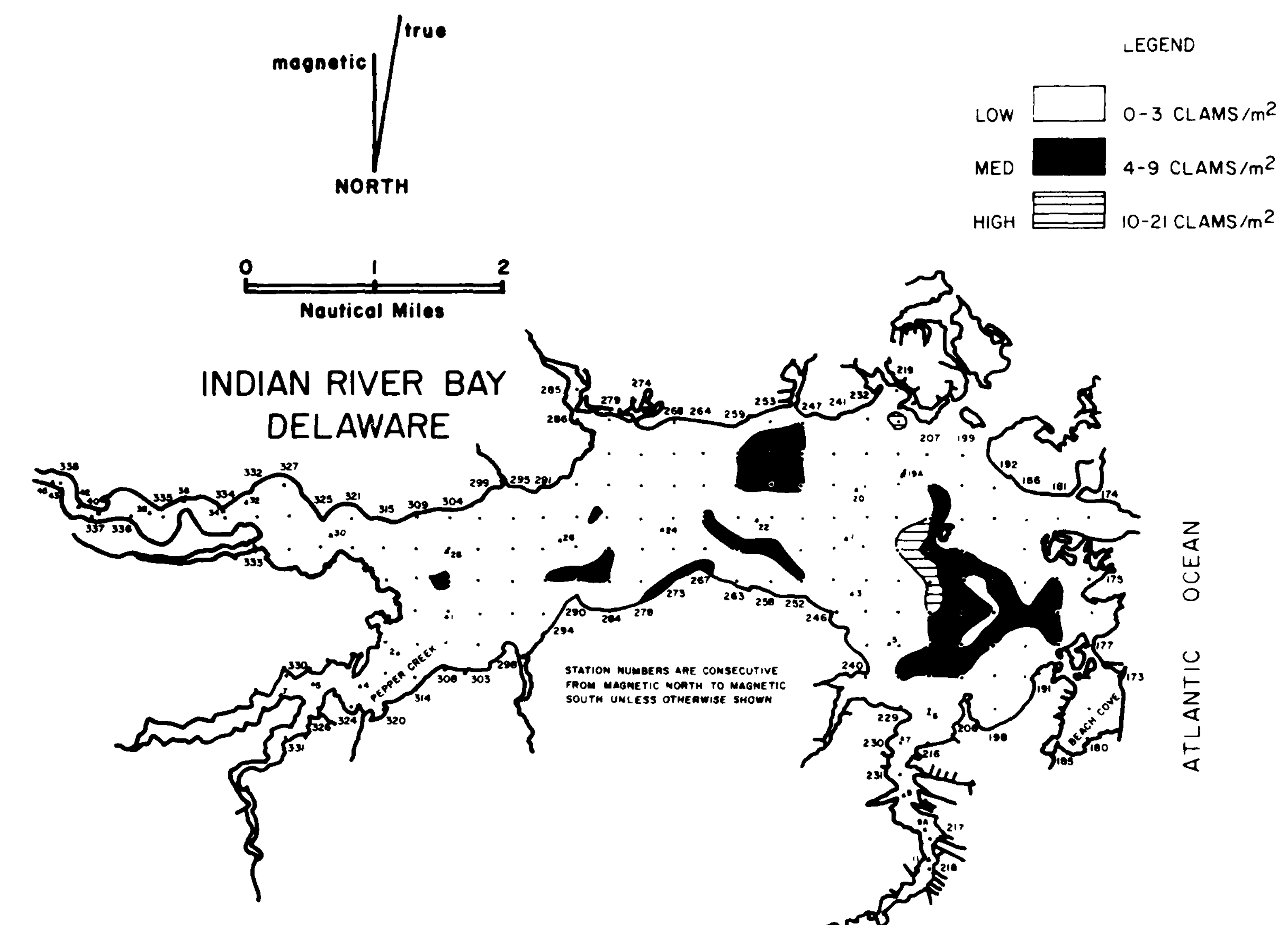


FIGURE 2



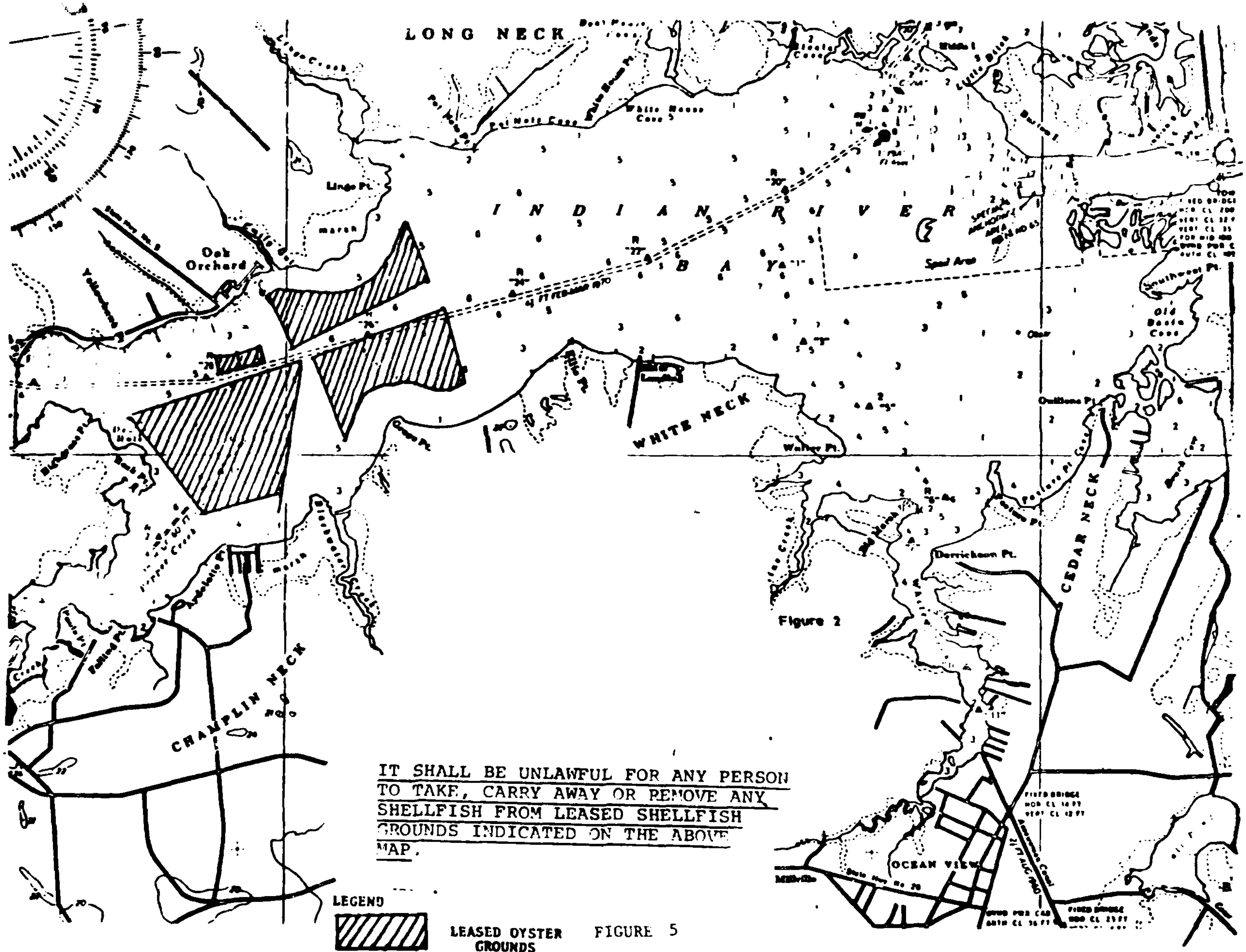
DENSITY DISTRIBUTION OF *Mercenaria mercenaria* IN THE REHOBOTH BAY AREA

FIGURE 3



DENSITY DISTRIBUTION OF *Mercenaria mercenaria* IN THE INDIAN RIVER BAY AREA

FIGURE 4



IT SHALL BE UNLAWFUL FOR ANY PERSON TO TAKE, CARRY AWAY OR REMOVE ANY SHELLFISH FROM LEASED SHELLFISH GROUNDS INDICATED ON THE ABOVE MAP.

FIGURE 5

DOCUMENT 40-05/78/02/2

DELAWARE HARD CLAM LANDING 1964-1975

YEAR	HARD CLAMS (lbs)
1964	164,200
1965	326,500
1966	264,000
1967	299,000
1968	239,000
1969	135,000
1970	89,000
1971	113,000
1972	90,000
1973	63,400
1974	101,000
1975	34,400

FROM: Cole, 1977

TABLE 1

SEAFOOD LANDINGS IN DELAWARE

	FISH		SHELLFISH	
	POUNDS	DOLLARS	POUNDS	DOLLARS
1972	810,500	141,248	11,737,700	2,330,854
1973	1,151,700	290,561	9,508,800	1,894,868
1974	758,500	189,471	8,455,700	1,538,349
1975	797,200	205,969	6,258,100	1,510,925
1976	727,500	231,328	6,441,400	1,727,651
1977	945,500	250,042	1,511,700	632,385

TABLE 2

Estimates of fishing pressure and 95% confidence intervals on Delaware marine waters as determined from 29 aerial counts conducted April 1 - October 31.

Type of Fishing	Man-days
Boating man-days (small fishing boats)[a]	436,133.0 ± 158,255.7
Party boat man-days[b]	163,482.5 ± 51,169.7
Man-days of shore, pier, surf fishing	226,128.5 ± 33,940.0
Man-days of recreational clamming	78,407.3 ± 44,485.0
Man-days of recreational crabbing	60,421.8 ± 17,241.7

[a]Man-days of fishing from small boats were calculated by multiplying boat days (155,761.8) by 2.8 people/boat.

[b]Man-days of fishing from party boats were calculated by multiplying party-boat days (6,146.0) by 26.6 people/boat.

TABLE 3

PERCENT OF TOTAL FISHING PRESSURE IN DELAWARE MARINE AREAS

TYPE OF FISHING	DELAWARE RIVER AND BAY	ATLANTIC OCEAN	ATLANTIC COASTAL BAYS
small boats	59.0	5.9	35
recreational clamming	3.7	0	96.1
recreational crabbing	53.7	0	46.3

FROM: Miller, 1978

TABLE 4

THREATENED AND ENDANGERED SPECIES OF DELAWARE

COMMON NAME	SCIENTIFIC NAME	FEDERAL STATUS
Shortnose sturgeon	Acipenser brevirostrum	Endangered
Atlantic (kemp's) Ridley Sea turtle	Lepidochelys kempi	Endangered
Loggerhead turtle	Caretta caretta caretta	Threatened
Leatherback sea turtle	Dermochelys coriacea	Endangered
Brown pelican	Pelecanus occidentalis	Endangered
Bald eagle	Haliaeetus leucocephalus	Endangered
American peregrine falcon	Falco peregrinus anatum	Endangered
Artic peregrine falcon	Falco peregrinus tundrius	Endangered
Blue Whale	Balaenoptera musculus	Endangered
Finback Whale	Balaenoptera physalus	Endangered
Sei Whale	Balaenoptera borealis	Endangered
Bowhead Whale	Balaena mysticetus	Endangered
Right Whale	Eubalaena glacialis	Endangered
Humpback Whale	Megaptera novaeangliae	Endangered
Sperm Whale	Physeter catodon	Endangered

TABLE 6

SECTION C-3

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
112 West Foster Avenue
State College, PA 16801

April 23, 1979

Colonel James G. Ton
Philadelphia Corps of Engineers
Custom House, 2nd & Chestnut Streets
Philadelphia, Pennsylvania 19106

Dear Colonel Ton:

In accordance with our FY79 Scope of Work agreement for the Delaware River Dredging Disposal Study, attached is our preliminary report "Fish and Wildlife Inventory of the Lower Delaware River and Bay Region."

Sincerely yours,

Michael T. Chezik

for Charles J. Kulp
Field Supervisor

Fish and Wildlife Inventory of the Lower Delaware River and Bay Region

Prepared For:

The Philadelphia District
Army Corps of Engineers
Delaware River Dredging
Disposal Study

Prepared By:

U.S. Fish and Wildlife Service

April 1979

TABLE OF CONTENTS

I. Introduction

This is a preliminary report on fish and wildlife resources of the lower Delaware River and Bay Region, provided in response to the Philadelphia District, Army Corps of Engineers, Delaware River Dredging Disposal Study. The purpose of the Congressionally authorized study is to develop a regional dredging spoil disposal plan for the tidal portions of the Delaware Bay, extending from Trenton, New Jersey, to the sea. The study was authorized by the United States Senate Committee on Public Works on September 20, 1974.

This report contains brief descriptions of finfish, benthic invertebrates, commercial and recreational fisheries, wetland wildlife and uses, and threatened/endangered species. It also contains a short discussion identifying areas sensitive to the disposal problem. The report addresses the river, bay, tidal segments of tributaries to each, and adjoining wetlands. Inland habitats are excluded from the discussion.

This report is submitted in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). It has been coordinated with the New Jersey Division of Fish, Game and Shellfisheries; the Delaware Division of Fish and Wildlife; the Pennsylvania Game and Fish Commissions; and the National Marine Fisheries Service.

II. Finfish

Delaware River

Homa (1978) reviewed benthic invertebrate and finfish literature for the Delaware River between Trenton (RM133) and the Chesapeake and Delaware Canal (RM53). His review emphasized shallow water areas while omitting deepwater and tributary habitats. Studies concerning the omitted habitats are briefly discussed below.

Miller et al (1974) conducted deepwater trawling at five stations in the Delaware River between Trenton and the Chesapeake and Delaware Canal during August to December 1973. The station names and locations are as follows: Trenton, RM 127-131; Bristol, RM-114-118; Bridesburg, RM 114-118; Philadelphia, RM 127-131; and Chester, RM 81-86. Eight-hundred and forty-three collections produced 15,043 fish of 21 species. Blueback herring made up 42 percent of the catch. Other species were white perch, 31 percent; spotted shiner, 8 percent; channel catfish, 6 percent; and white catfish, 5 percent (Table 1). In addition to these stations, the Schuylkill River, Neshaminy Creek and the main river adjacent to Wilmington were periodically trawled during this period. One hundred and forty-three collections produced 3,082 fish of 16 species. Blueback herring, spot, white perch and satinfin shiner made up 43, 38, 5 and 5 percent of the catch, respectively (Table 2).

In a separate study, Miller et al (1974) sampled 14 Delaware River tidal tributaries between Trenton and Wilmington from April to November 1973. A total of 14,410 fish of 31 species were collected by seine and trawl. Anadromous species were taken in all 14 tributaries. Blueback herring accounted for 91 percent of the anadromous catch followed by white perch (5 percent), alewife (4 percent) and American shad and striped bass (<1 percent). Blueback herring and alewife were generally more abundant in the tributaries which held the greatest variety and/or number of fish (Table 3).

Additional fish sampling was undertaken in the lower reaches of the Christina River and Brandywine Creek in spring and summer, 1978. Electrofishing by boat in the Christina River produced 12 species. The most abundant fish were carp, silvery minnow, menhaden, alewife and blueback herring. Similar sampling of the lower reach of Brandywine Creek resulted in 28 species collected. The most abundant fish in the Brandywine sampling were silvery minnow, carp, blueback herring, spottail shiner, white sucker, American Eel, alewife and white perch (Reichard, 1978).

Fish surveys by the Pennsylvania Fish Commission confirm that Darby Creek, Pennypack Creek and Neshaminy Creek support runs of blueback herring and alewife. American shad are not known to spawn in any of the Pennsylvania tributaries (Marshall, 1978)

The New Jersey Division of Fish, Game and Shellfisheries has surveyed several of the New Jersey tributaries in this reach. The results of their surveys were recently compiled and included in the Service's "Planning Aid Report: Existing Fish and Wildlife Resources Related to the Southern New Jersey Water Resources Study, Burlington, Camden and Gloucester Counties, New Jersey" (U.S. Department of the Interior, 1978).

Delaware Bay

Study of finfish in Delaware Bay began in the early 1950's. Since then, numerous studies have emphasized the variety of finfish present within the estuary. These include reports by Daiber (1954 a and b); Fitz (1956); June and Reintjes (1957); Harmic (1958); Bearden (1959); Reintjes and Roithmayr (1960); de Sylva and Kalber (1960); de Sylva, Kalber and Shuster (1962); Murawski (1966); Daiber and Abbe (1967); Daiber and Wockley (1968); Raney, Schuler and Denoncourt (1969); Smith (1969); Daiber and Smith (1969, 1970 and 1971 a and b); and Bason (1971). Many of these studies and others are briefly described in Polis (1972), Maurer and Wang (1973) and Maurer (1974).

Two hundred and eighteen species of finfish have been collected from the Delaware Bay region (Maurer and Wang, 1973) (Table 4). Nearly half of these are restricted to the higher salinity waters. About 40 species occur in marine and brackish water. Another 40 species occupy marine, brackish and freshwater. The remainder inhabit brackish and freshwater or freshwater.

Studies by de Sylva, Kalber and Shuster (1962) and Abbe (1967) indicate that the estuary is primarily important as a breeding ground for fish (over 60 species) and a nursery for juveniles.

Upper Estuary

Thomas (1971) collected 90 species of finfish from the Artificial Island area, including the river and four tidal creeks (Appoquinimink, Blackbird, Alloway and Hope Creeks) (Table 5).

Schuler (1971) collected 42,000 fish comprising 42 species in daylight seine samples. The 10 most abundant species, comprising 98 percent of the total, were Atlantic silverside, bay anchovy, blueback herring, mummichog, Atlantic menhaden, striped bass, white perch, alewife, rough silverside and tidewater silverside. Over 45,000 specimens were collected in daylight bottom hauls. Of these, 99 percent consisted of bay anchovy, weakfish, white perch, hogchoker, alewife, blueback herring, American eel, striped bass, bluefish and brown bullhead. According to Schuler, the Artificial Island area is an important nursery for weakfish, white perch striped bass and black drum, all sportfish species.

Lower Estuary

Daiber and Smith (1971 b) conducted the most recent comprehensive survey of finfish in the bay below Cohansey River during 1966 through 1970. A total of 136,093 fish of 69 species was caught. Weakfish (31 percent), hogchokers (23 percent), scup (13 percent), northern sea robin (4 percent) and windowpane (4 percent), comprised three-fourths of the catch (Table 6). Species diversity was less in the upper bay than in the lower bay and was greatest everywhere during the summer and fall.

Daiber (1954 b) gives the relative abundance of fish taken in commercial trawl samples during 1951 through 1954. The 10 most abundant fish were weakfish, spot, scup, hogchoker, summer flounder, northern sea robin, Atlantic croaker, spotted hake, butterfish and white perch. Five of Daiber's top 10, the summer flounder, Atlantic croaker, spotted hake, butterfish and white perch, all important recreational and commercial

species, do not occur in the top 10 of the 1971 study. The studies suggest that the smooth dogfish, roughtail ray, bullnose ray and striped sea robin are slowly becoming more abundant, while the clearnose skate, silver hake, summer flounder and northern puffer are, in general, declining in abundance.

Tidal Tributaries

Although the New Jersey Division of Fish, Game and Shellfisheries has surveyed many of the streams draining into Delaware Bay, most were surveyed in the upper non-tidal reaches. Fishery data for the tidal segments are scarce. The Maurice River is an exception. Himchak (1978) and McClain (1978) sampled ichthyoplankton and finfish in the lower Maurice from October 1975 to September 1976. Planktonic forms of 23 fish species were collected. Bay anchovy, naked goby, Atlantic croaker, spot, menhaden and American eel made up 98 percent of the collection. Additional species were taken as either adults or juveniles.

Many streams in New Jersey support spawning runs of alewife or blueback herring (Table 7). None are known to support spawning runs of American shad.

Martin (1974) sampled 13 Delaware tidal streams draining into Delaware Bay. These included Reybold Creek, Silver Run, Appoquinimink River, Blackbird Creek, Smyrna River, Leipsic River, Simons Creek, Mahon River, Little River, St. Jones River, Murderkill River, Mispillion River and Broad Creek. Indian River, Rehoboth and Little Assawoman Bays were also sampled. The results show tidal streams are important nursery, forage and spawning habitats for a variety of fishes. Species commonly present in adult and/or juvenile stages are white perch, weakfish, spot, menhaden, American eel, blueback herring, alewife, striped bass, bay anchovy, naked goby, white mullet, winter flounder and silverside shiner. The less saline segments usually contain white catfish, channel catfish, carp and yellow perch.

III. Benthos

The first published account of benthic assemblages in Delaware Bay was a paper on the associated oyster fauna (Maurer and Watling, 1973). A series of papers dealing with the distribution and ecology of specific taxa was also completed: Amphipoda (Watling and Maurer, 1972a); Hydroids (Watling and Maurer, 1972b); Pelecypoda (Maurer, Watling and Aprill, 1974); Isopoda (Watling, Lindsay and Maurer, 1974); and Gastropoda (Leathem and Maurer, 1975). Additionally, Kenner, Maurer and Leathem (1975) described animal-sediment associations of dominant benthic species.

Watling, Maurer and Wethe (1976) undertook the first comprehensive sampling of benthic invertebrates in Delaware Bay. During July and August 1972 and June and July 1973, 207 samples were taken along 26 transects between Cape Henlopen and Stone Creek. One hundred and nine species were obtained during 1972 and 125 during 1973 (Table 8). There were no significant changes in relative abundance of phyla from one year to the next. The average numer of individuals per sample for both 1972 and 1973 was 20 (200 individuals/m^2). At only ten stations of the 207 sampled were there more than 1,000 individuals/m^2. The authors suggested the low densities were due to a lack of attached benthic macroscopic algae or vascular plants in the bay, which in turn, was most likely related to the highly turbid conditions in the bay. The absence of macroscopic benthic algae deprives the benthic community of a major source of organic material that would be used by deposit feeders. The most widespread species were Tellina agilis, Heteromastus filiformis, Glycera dibranchiata, Nephtys picta, Mulinia lateralis, Protohaustorius wigleyi, Gemma gemma and Nucula proxima.

Benthic invertebrate studies for the Delaware River are described by Homa (1978). We were unable to locate any relevant information not covered in Homa's report.

IV. Commercial Fisheries

The National Marine Fisheries Service, Department of Commerce records commercial finfish and shellfish catches within the Delaware River and Bay. The mean values for catches recorded from 1960 through 1977 and from 1973 through 1977 are approximately $1.7 and $3.1 million respectively (Table 9).

Species composition, poundage and value of 1977 commercial finfish and shellfish catches for Delaware Bay and River, are given in Table 10. Oysters comprised 70.0 percent of the total harvest value. Blue crabs were a distant second at 19.1 percent followed by sea trout 4.0 percent, eel 2.5 percent, and striped bass 1.5 percent Together these five species made up 97.1 percent of the total 1977 harvest value.

Analysis of catches landed from the New Jersey side of Delaware Bay, 1948 through 1975, reveals that oysters comprised 85.6 percent of the harvest value (Table 11). Other species comprising the top 5 were blue crab (7.9 percent), menhaden (2.5 percent), hard clam (1.0 percent) and striped bass (0.7 percent). Together these 5 species comprised 97.7 percent of the 1948-1975 harvest value (New Jersey side only).

The paramount importance of the oyster to commercial fisheries in Delaware Bay, both in the past and present, is evident from the catch data. A description of the oyster industry is found in the Service's planning aid report: "The Effect of Salinity Change on the American Oyster in Delaware Bay (1979)."

Second in importance is the blue crab. It occurs from the vicinity of Philadelphia to the mouth of the bay, and is commonly found in tidal tributaries. Harvesting is by potting and dredging. Potting occurs during non-winter months, while dredging is a winter time activity restricted to deepwater sediments. Approximately 3,000 acres of bay bottom in New Jersey are leased for dredging crabs. In Delaware leasing is not a requirement, but fisherman may not dredge in leased oyster grounds. Most dredging occurs in the lower bay.

In the past and occassionally in recent years (e.g., 1974) the Atlantic menhaden has been an important species. According to Homa (1978) menhaden probably spawn in the deeper areas of Delaware Bay. They use the shore zones and tidal creeks of the lower estuary as nursery areas. Menhaden are processed for fish meal and oil.

Besides being an important sportfish, the weakfish is also a valuable commercial species. Weakfish enter the bay in early May. Spawning occurs from late May to early August along the shoals and in the Delaware River. Juveniles are found in upper tidal tributaries such as Silver Run, Appoquinimink, Blackbird, Smyrna and Mahon Creeks in Delaware (Martin 1974) and Alloway, Hope (Smith 1971); Dividing and Oranoaken Creeks (McClain 1978), New Jersey. In late September, the large weakfish begin leaving the bay, followed by the smaller fish and eventually the young of year (Martin 1974).

The striped bass is another fish with both commercial and recreational importance. Formerly a common migrant in the Delaware River, it now spawns primarily in the vicinity of Artificial Island and in the Chesapeake and Delaware Canal. The juveniles inhabit tidal streams until their third year when they travel to the ocean (Martin 1974).

The American eel is a catadromous species. It spawns in the Atlantic Ocean, but migrates to brackish or freshwater to spend most of its juvenile and adult life. The eel prefers muddy bottom streams and is present throughout the lower Delaware drainage.

The hard clam is widely distributed throughout lower Delaware Bay, but is not present in commercial densities. A 1972 survey of the west side of the bay disclosed two areas with potential as commercial clam beds: Joe Flogger and Old Bare Shoals (Keck, Watling and Maurer, 1972).

V. Recreational Fisheries

In 1961, the Fish and Wildlife Service estimated that approximately 130,000 saltwater sportfishermen annually devote 900,000 man-days to fishing within Delaware Bay. Most of these were finfishermen. However, an uncounted number also engaged in clamming and crabbing. The six finfish species that accounted for the largest annual harvests by sportfishermen were bluefish, scup, weakfish, summer flounder, sea bass and croaker (U.S. Fish and Wildlife Service, 1962).

Martin (1973) reported 330,935 man-days of sportfishing from boats in western Delaware Bay in 1973, with an average number of 2.8 anglers per private boat, 8.0 per charter boat and 38.5 per head boat. Weakfish comprised 90 percent of the 1971-73 sport catch.

Using Martin's data, Smith (1975) estimated that boat fishing contributes $4.5 million to the west bay economy. He also determined from use surveys that boat fishing was concentrated in the lower bay, especially in areas associated with the navigation channel running through the Ship Anchorage or lightering area; that weakfish, summer flounder, black sea bass, and black drum were the primary species sought by Delaware head boats; and that the mean number of sportfishing boats in western Delaware Bay on weekdays and Sundays was 180.4 ± 6.9 and 447.6 ± 162.3, respectively.

The most recent (1976) survey of sportfishing in Delaware by Miller (1977) showed no appreciable change in sportfishing effort by boaters since 1973. However, shore fishing effort had appreciably increased from 128,512 man-days in 1973 to 225,129 man-days in 1976. The author cautioned that any real differences in fishing pressure could have been masked by differences in survey compilation techniques. Future studies on sportfishing in Delaware, occuring at approximately three year intervals, should avoid this problem.

For eastern Delaware Bay (Salem, Cumberland and Cape May Counties) an estimated 300,000 to 650,000 man-days of sportfishing effort are expended annually from April through November. Boat fisherman account for 75 to 80 percent of the effort and about 95 percent of the catch. At least 85 percent of the fish landed by boat fisherman are weakfish. Boat fisherman also catch summer flounder, bluefish, spot, striped bass, black sea bass, white perch, kingfish, winter flounder, black drum, shark, carp, catfishes, and American eel. White perch make up from a third to a half of the catch of shore fisherman, with summer flounder, bluefish, striped bass, spot, winter flounder, catfishes, carp and American eel making up the remainder (U.S. Fish and Wildlife Service, 1975).

The Pennsylvania Fish Commission (1975) estimates that the Delaware River in Philadelphia and Delaware Counties provides approximately 56,000 man-days of fishing annually for alewife, blueback herring, shad, bullhead, sucker, sunfishes, carp and eel. The Schuylkill River in Philadelphia County provides approximately 43,000 man-days for identical species, including muskellunge.

Fisherman use estimates for the New Jersey side of the river are not available. However, we would expect an amount similar to that occurring from Pennsylvania.

Fisherman use data for the tidal tributaries is generally lacking. Martin (1974) provides guidance to fishermen on where and how to catch fish in the Delaware tributaries, but does not indicate a current level of use. Figley (1978) conducted a year-long use survey of the Maurice River estuary between October 1975 and September 1976. Part of the survey included a section of Delaware Bay (Maurice River Cove). As might be expected, recreational use peaked during summer (August) and reached a low point in winter (January). Bank and boat fishing amounted to 15,986 and 15,179 man-days respectively.

Based on the survey information available, fisherman use of the lower Delaware River, Delaware Bay and tidal tributaries is at least 1.2 million man-days per year. We estimate that 90 percent of the use is by saltwater anglers and 10 percent is by warmwater fishermen. Since saltwater fishermen spend an average $16.65 per man-day of angling (U.S. Department of the Interior, 1977), saltwater fishermen annually contribute an estimated $18.0 million to the regional economy. The average man-day expenditure by warmwater fishermen is $8.48. Therefore, the annual contribution from warmwater fishermen is $1.0 million. We regard these as conservative estimates. Additional fisherman use surveys, particularily on the tidal tributaries, might increase these estimates.

VI. Wetland Wildlife and Uses

A 1973 survey by the Academy of Natural Sciences disclosed that the Delaware River, estuary and tributaries between Trenton, New Jersey and Cape May - Henlopen drain approximately 176,000 acres of freshwater and brackish water wetlands (1). Approximately 10,000 acres are of the freshwater type and occur between Trenton, New Jersey and Wilmington, Delaware. The remaining 166,000 acres are mainly brackish and occur between Wilmington and Cape May - Henlopen. The more common freshwater wetland plants are Scirpus americanus, S. olneyi, Polygonum punctatum, various species of Eleocharis and Sagittaria, Zizania aquatica, Peltandra virginica, Nuphar advena and species of Pontederia and Lythrum. Where channelization, ditching or filling has occurred, Phragmites communis is often dominant. Brackish water vegetation is characterized by Spartina alterniflora, S. patens and Distichlis spicata (The Academy of Natural Sciences, 1973).

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(1) A 1961 survey by the Service disclosed approximately 206,000 acres of wetlands within the Coastal Plain physiographic section. The 1961 survey encompassed a slightly larger area than did the Academy of Natural Sciences survey, and this largely accounts for the disparity between the two survey estimates.

The freshwater and brackish water wetlands and adjoining upland provide essential habitat for a variety of vertebrates collectively identified as wetland wildlife. As least 144 species of birds, including 30 species of waterfowl, 39 species of shore and wading birds, 16 birds of prey and 59 others, occur in or near wetlands. Added to these are 22 amphibians, 22 reptiles and 17 mammals, all occurring in or near wetlands.

An estimated 300,000 ducks and geese overwinter in these wetlands. About 225,000 (76 percent) inhabit the Delaware marshes. Of these, 150,000 are Canada geese (Graham, R. 1979). Approximately 55,000 waterfowl (18 percent) overwinter in New Jersey (U.S. Fish and Wildlife Service, 1975). Wetlands in Pennsylvania, principally Tinicum Marsh, overwinter the remaining 20,000 (7 percent). Over 75 percent of the Pennsylvania waterfowl are diving ducks (W. Drasher 1979). Although most of the 300,000 waterfowl leave the basin wetlands after winter, a substantial number, mainly puddle ducks, remain to breed.

A 1977-78 survey of waterfowl hunting in the Delaware portion of the basin disclosed that 22,200 hunters expended 183,600 man-days hunting ducks, geese and rails (Florio 1979). A similar survey of the New Jersey portion in 1974-75 disclosed 17,800 hunters and 115,400 man-days (New Jersey Division of Fish, Game and Shellfisheries, undated).(1) Such surveys have not been conducted in Pennsylvania. However, the Pennsylvania Game Commission indicates that hunting pressure there is substantially less than in New Jersey (Drasher 1979). Based on the two surveys and a conservative guess in Pennsylvania, we estimate that the basin below Trenton annually provides 43,000 hunters 320,000 man-days of waterfowl hunting. Since migratory bird hunters spend an average $10.82 per man-day of hunting (U.S. Department of Interior, 1977), waterfowl hunters annually contribute an estimated $3.5 million to the regional economy.

The basin wetlands also support a valuable fur industry. Muskrat and raccoon are most important. Other less important species are red and gray fox, opposum, mink, weasel and skunk.

A 1977 survey of trapping in New Jersey revealed that 1,369 trapping licenses were sold in counties comprising the New Jersey side of the basin (1). Trappers expended approximately 77,000 man-days trapping within these counties. The harvest was valued at $1.4 million (New Jersey Division of Fish, Game and Shellfisheries, 1977). In Delaware, a 1977-78 survey revealed that 2,000 trapper/hunters expended 41,000 man-days trapping muskrat and trapping/hunting raccoon. The total furbearer harvest from the Delaware side of the basin was valued at $.5 million. Surveys of furbearer harvests in Pennsylvania have not been undertaken. Because Pennsylvania has the least amount of wetland and is

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(1) Burlington, Camden, Cape May, Cumberland, Gloucester and Salem.

the most developed of the three states, it is reasonable to expect that it produces the lowest furbearer harvest. Considering the two surveys and a conservative guess of the Pennsylvania harvest, we estimate the annual value of the furbearer resource below Trenton at $2.1 million.

According to the "1975 National Survey of Hunting, Fishing and Wildlife - Associated Recreation," 27 percent of the U.S. population 9 years or older in 1975 participated in wildlife observation and 8 percent engaged in wildlife photography. Wildlife observation amounted to 1.6 billion man-days or 33 man-days per wildlife observer. Wildlife photography totaled 156.7 million man-days or 10 man-days per wildlife photographer (U.S. Department of Interior, 1977).

The Delaware River Basin Commission estimates that 1.8 million people reside in the Coastal Plain section of the basin (Kausch 1979). According to the national average, 86 percent or approximately 1.5 million of these people are 9 years of age or older. Using the referenced population percentages for wildlife observer (27 percent) and wildlife photographer (8 percent), we estimate the numbers of wildlife observers and wildlife photographers in the Coastal Plain are 405,000 and 120,000 respectively. The estimated numbers of man-days expended on wildlife observation and wildlife photography are 13.4 million and 1.2 million, respectively. The 1975 national survey did not indicate average expenditures for wildlife observers or wildlife photographers. However, if each wildlife observer and photographer spent only $10 annually, the contribution to the economy would be $5.3 million. The actual value is probably higher.

VII. Threatened/Endangered Species

The lower Delaware River and Bay Region is within the historic range of 17 federally designed threatened or endangered species (Table 12): seven whales, five marine turtles, four birds and one fish. The whales and turtles are primarily oceanic, but occassionally venture into Delaware Bay. Three of the birds are raptorial and migrate through the area. The other bird, the brown pelican, is a rare visitor. The shortnose sturgeon inhabits the river and possibly the upper bay.

Information on the specific distribution of these species and their life requirements is often fragmentary. This is particularily true of the shortnose sturgeon, a bottom dwelling fish potentially most likely to be affected by dredging/filling. The little information known about the shortnose is mainly the result of research conducted from the St. John River, New Brunswick. This work and other relevant studies were recently summarized in the Fish and Wildlife Service publication "Development of Fishes of the Mid-Atlantic Bight" (1978). A copy of the summary is included at the end of this report. Also included is a summary of recent shortnose collections from the Delaware River made by biologists from the Delaware River Basin Anadromous Fishery Project, Rosemont, New Jersey (Table 13).

No federally designated or proposed threatened or endangered plants occur within the project area. However, four indigenous plants are being considered for addition to the threatened species list (Federal Register, Volume 40, No. 127, July 1, 1975). These are Nuttall's micranthemum, purple fringeless orchis, Long's bulrush and Pine Barren's reedgrass. It should be emphasized that none of these species have been officially proposed for addition to the threatened list. Therefore, they are not currently subject to the protection afforded by the Endangered Species Act, as amended in 1978. We mention them simply because they could be officially proposed during project planning, which would then make them subject to the Act.

Nuttall's micranthemum, Micranthemum micranthemoides, a member of the figwort family, is normally found on tidal mudflats. Collectors have taken specimens adjacent to the Delaware River in Bucks and Philadelphia Counties, Pennsylvania and Camden and Burlington Counties, New Jersey. It has also been recorded from similar habitat in Delaware.

Purple fringeless orchis, Habenaria peramoena, a member of the orchid family, occurs in meadows, bogs, alluvial thickets and low woods. It may also be found along saltmarsh margins. Collectors have taken specimens in Camden and Cape May Counties, New Jersey and Chester County, Pennsylvania. It has also been taken in Delaware.

Long's bulrush, Scirpus longii, occurs in freshwater marshes and swamps in Burlington County, New Jersey.

Pine Barren's reedgrass, Calamovilfa brevipilis var. brevipilis, occurs in swamps and bogs of Burlington and Cape May Counties, New Jersey.

Species designated as threatened or endangered by the individual basin states are shown in Tables 14 and 15. The Delaware list (not shown) is the same as the Federal list. Pennsylvania currently does not have a list of threatened or endangered birds and mammals.

This section does not fulfill requirements in accordance with Section 7 of the Endangered Species Act, as amended in 1978. For specific guidance on formal consultation procedures, we recommend the Corps review the Federal Register, Volume 43, No. 2, dated January 4, 1978.

VIII. Areas Sensitive To The Disposal Problem

Our current knowledge of fish and wildlife resources in the lower Delaware River Basin is largely the result of a long succession of proposals to modify the environment. This is not an unusual situation and commonly occurs elsewhere in the United States. Unfortunately, the value of sporadic biological study is quite limited. This is particularily true

for the study of estuarine biota, which depend upon or are subject to a myriad of natural or artificial regulations, including temperature, flow, salinity, water quality, substrate, food, season, cover, etc. Any one of these factors and certainly many more individually or synergistically determine species presence, abundance, activity and human use. Despite such variables, certain generalizations are valid and have long been noted in our correspondence to the Army Corps of Engineers.

Wetland plants, including emergent, submergent and floating leaf hydrophytes, nearly always provide valuable habitat for fish and wildlife. They provide food and cover for many species and also serve as sites for reproduction and early growth. The study area still has a significant wetland acreage. Unfortunately over 90 percent of the wetlands occur south of Wilmington. Therefore, remaining wetlands north of this city take on added importance. The Service is committed to protection of all wetlands and generally seeks opportunities to create additional wetland areas. We particularily would like to see new wetlands created between Trenton and Philadelphia.

Non-vegetated shallow water areas also provide food, cover and nursery and spawning habitat. Although it is not well-documented, the current biological opinion is that non-vegetated shallows can be made more productive by establishing wetland plants. This generalization is not necessarily true for all shallows, or for that matter, all species. For example, smallmouth bass seek out gravel bottom shallows for spawning.

The Service is generally protective of shallow water areas, particularily where water quality is good or is likely to improve. We occassionally approve conversion of deepwater areas into shallow water habitats, but prefer that the shallows, once created, also be planted with wetland vegetation. These proposals must be reviewed on a case by case basis.

Vegetated wetlands and shallow water areas, are not the only sites sensitive to the disposal problem. Other sensitive areas include oyster seed beds and leased areas, blue crab dredging areas, hard clam beds, spawning and nursery grounds for important commercial/recreational finfish and islands. Islands serve as natural refuges for migrating waterfowl and other bird life and are sometimes heavily used for nesting (e.g., Pea Patch Island).

In general, the body of biological information available suggests that developed areas are least valuable for fish and wildlife. A good example of this is the Philadelphia - Wilmington corridor which has a limited fish population for about half the year. The problem is due mainly to poor water quality. Even if water quality significantly improved, it is likely that fish productivity there would still be lower than in other less developed areas where habitat is more diverse. Improved water quality would, however, significantly benefit migratory species (e.g., American shad).

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X. Tables and Supplement

Table 1 SUMMARY OF TOTAL CATCH BY NUMBER, RANK, AND PERCENT FOR FIVE TIDAL RIVER TRAWLING STATIONS, DELAWARE RIVER - 1973

	Rank	Trenton	Bristol	Bridesburg	Philadelphia	Chester	Total	% Total Catch
No. Species		13	16	13	10	14	21	
No. Specimens		3899	7920	2217	365	642	15043	
No. Collections		156	159	180	177	171	843	
Blueback Herring	1	678	3670	1425	158	427	6358	42.3
White Perch	2	1533	2578	367	43	71	4592	30.5
Spottail Shiner	3	1032	132	27	4	1	1196	8.0
Channel Catfish	4	53	862	40	0	0	955	6.3
White Catfish	5	420	275	82	1	2	780	5.2
Alewife	6	66	241	85	57	2	451	3.0
Silvery Minnow	7	19	34	6	85	110	254	1.9
American Eel	8	8	14	176	8	5	211	1.4
Brown Bullhead	9	73	13	1	1	12	100	0.7
Bluegill	10	0	74	0	0	4	78	0.5
Tessellated Darter	11	11	10	1	0	0	22	0.1
American Shad	12	4	9	0	2	0	15	*
Striped Bass	13	0	1	3	0	4	8	*
Mummichog	14	0	0	0	6	1	7	*
White Sucker	15	0	5	0	0	0	5	*
Gizzard Shad	16	1	0	2	0	1	4	*
Banded Killifish	17	0	0	2	0	1	3	*
Largemouth Bass	18	0	1	0	0	0	1	*
Fallfish	18	1	0	0	0	0	1	*
Carp	18	0	0	0	0	1	1	*
Golden Shiner	18	0	1	0	0	0	1	*

* - Less than one-tenth percent

Table 2 SUMMARY OF TOTAL CATCH BY NUMBER, RANK, AND PERCENT AT THREE ADDITIONAL TRAWLING STATIONS, TIDAL DELAWARE RIVER - 1973

Species	Rank	Wilmington	Neshaminy Creek	Schuylkill River	Total	% Total Catch
No. Species		12	5	4	16	
No. Specimens		2846	83	153	3082	
No. Collections		30	5	26	106	
Blueback Herring	1	1316	72	0	1388	43.4
Spot	2	1169	0	0	1169	37.9
White Perch	3	155	2	0	157	5.1
Satinfin Shiner	4	0	0	150	150	4.9
Spottail Shiner	5	85	1	0	86	2.8
American Eel	6	65	0	0	65	2.1
Alewife	7	39	0	0	39	1.3
Bluegill	8	0	7	1	8	0.3
Striped Bass	9	7	0	0	7	0.2
Brown Bullhead	10	5	0	1	6	0.2
Yellow Perch	11	2	0	0	2	*
American Shad	12	0	1	0	1	*
Black Crappie	12	1	0	0	1	*
Carp	12	1	0	0	1	*
Mummichog	12	0	0	1	1	*
Pumpkinseed	12	1	0	0	1	*

*/ Less than one-tenth percent

Table 3 CATCH OF INDIVIDUAL ANADROMOUS SPECIES, NUMBER OF OTHER FISH, AND SPECIES DIVERSITY FROM 14 TIDAL DELAWARE RIVER TRIBUTARIES - 1973

Tributary Name	River Mile	American Shad	Blueback Herring	Alewife	Striped Bass	White Perch	Other Species	Variety Species	Total All Fish
1. Christina River	71	0	297	26	0	15	264	15	602
2. Brandywine Creek	71	0	1	0	0	0	2	3	3
3. Oldmans Creek	77	0	1200	4	0	2	244	11	1450
4. Raccoon Creek	81	0	778	4	0	2	591	15	1375
5. Darby Creek	85	0	3	0	0	0	1317	3	1320
6. Mantua Creek	90	0	70	1	0	2	379	9	452
7. Woodbury Creek	92	0	1968	191	0	65	1385	13	3609
8. Big Timber Creek	95	0	567	0	0	2	550	11	1119
9. Cooper River	102	0	44	0	1	167	458	11	670
10. Pennsauken Creek	105	0	444	23	0	0	187	8	654
11. Pennypack Creek	110	4	1	0	0	0	79	8	84
12. Rancocas Creek	111	1	835	0	0	87	758	16	1681
13. Neshaminy Creek	116	3	1050	49	0	93	170	14	1365
14. Crosswicks Creek	128	1	18	0	0	3	4	5	26
Total		9	7276	298	1	438	6388	31	14410

TABLE 4 List of fishes collected from the Delaware Bay Region. Type of species: M = Marine; B = Brackish (Sal. 1-10 ppt); F = Fresh. Primary activity in area: M = Migrant; SP = Spawning in Area; SF = Summer Feeding; WF = Winter Feeding; N = Nursery; R = Resident Species; ST = Stray

Species	Type of Species	Primary Activity in Area
PETROMYZONITIDAE - LAMPREYS		
Petromyzon marinus - Sea lamprey	M, B, F	M
CARCHARIIDAE - SANDSHARKS		
Carcharias taurus - Sandshark	M, B	SF
LAMNIDAE - MACKERAL SHARKS		
Alopias vulpinus - Thresher shark	M	SF
ODONTOSPIDIDAE - SAND TIGERS		
Odontaspis taurus - Sand Tigers	M	M
CARCHARHINIDAE - REQUIEM SHARKS		
Carcharhinus milberti - Sandbar shark	M	SF
C. obscurus - Dusky shark	M	ST
Mustelus canis - Smooth dogfish (Lewes)	M	SF
Prionace glauca - Blue shark	M	SF
Scoliodon terra and novae - Atlantic sharpnose shark	M	ST
SPHYRNIDAE - HAMMERHEAD SHARKS		

TABLE 4

Species	Type of Species	Primary Activity in Area
Sphyrna tiburo - Bonnethead	M	SF
S. zygaena - Smooth hammerhead	M	
TORPEDINIDAE - ELECTRIC RAYS		
Torpedo nobiliana - Atlantic torpedo	M	ST
SCYLIORHINIDAE - CAT SHARKS		
Scyliorhinus retifer - Chain dogfish	M	M
SQUALIDAE - DOGFISH SHARKS		
Squalus acanthias - Spiny dogfish	M	WF
SQUATINIDAE - ANGEL SHARKS		
Squatina dumerili - Atlantic angel shark	M	SF
RAJIDAE - SKATES		
Raja eglanteria - Clearnose skate	M	SF
R. erinacea - Little skate	M	WF
R. garmani - Rosette skate	M	ST
R. laevis - Barndoor skate	M	
R. ocellata - Winter skate	M	WF
R. radiata - Thorny skate	M	
DASYATIDAE - STINGRAYS		

TABLE 4 (cont.)

Species	Type of Species	Primary Activity in Area
Dasyatis centroura - Roughtail stingray	M	SF
D. sabina - Atlantic stingray (off Bowers)	M	
D. sayi - Bluntnose stingray	M	SF
Gymnura altavela - Spiny butterfly ray	M	
G. micrura - Smooth butterfly ray	M	
Urolophus jamaicensis - Yellow stingray	M	ST
MYLIOBATIDAE - EAGLE RAYS		
Myliobatis freminvillei - Bullnose ray	M	SF
Rhinoptera bonasus - Cownose ray	M	ST
CHIMAERIDAE - CHIMAERA		
Hydrolagus colliei - Ratfish	M	ST
ACIPENSERIDAE - STURGEONS		
Acipenser oxyrhyncus - Atlantic sturgeon	M, B, F	M
ELOPIDAE - TARPONS		
Megalops atlantica - tarpon	M	ST
ANGUILLIDAE - FRESHWATER EELS		
Anguilla rostrata - American eel	M, B, F	M, SF, N, R

TABLE 4 (Cont.)

Species	Type of Species	Primary Activity in Area
CONGRIDAE - CONGER EELS		
Conger oceanicus - Conger eel	M	
CLUPEIDAE - HERRINGS		
Alosa aestivalis - Blueback herring	M, B, F	SP, N
A. mediocris - Hickory shad	M, B, F	M (adults), SF (young)
A. pseudoharengus - Alewife	M, B, F	SP, N
A. sapidissima - American shad	M, B, F	M
Brevoortia tyrannus - Atlantic menhaden	M, B, F	N, SF
Clupea harengus harengus - Atlantic herring	M, B	
Dorosoma cepedianum - Gizzard shad	F, B	R, SP
Etrumeus teres - Atlantic round herring	M, B?	
Opisthonema oglinum - Atlantic thread herring	M	
ENGRAULIDAE - ANCHOVIES		
Anchoa hepsetus - Striped anchovy	M, B	ST
A. mitchilli - Bay anchovy	M, B, F	SP?, N, SF
Engraulis eurystole - Silver anchovy	M, B	
UMBRIDAE - MUDMINNOWS		
Umbra pygmaea - Eastern mudminnow	F	ST

TA 4

Species	Type of Species	Primary Activity in Area
ESOCIDAE - PIKES		
Esox americanus - Redfin pickerel	F, B	R, SP
E. niger - Chain pickerel	F, B	R, SP
SYNODONTIDAE - LIZARD FISHES		
Synodus foetens - Inshore lizard fish	M	
CYPRINIDAE - MINNOWS AND CARPS		
Carassius auratus - Goldfish	F, B	R, SP?
Cyprinus carpio - Carp	F, B	R, SP
Exoglossum maxillingua - Cutlips minnow	F, B	R, SP
Hybognathus nuchalis - Silvery minnow	F, B	R, SP
Notemigonus crysoleucas - Golden shiner	F, B	R, SP
Notropis analostanus - Satinfin shiner	F	R, SP (upper crk lak
N. bifrenatus - Bridle shiner	M, B	WF
N. hudsonius - Spottail shiner	F, B	R, SP
Rhinichthys atratulus - Blacknose dace	F	ST
CATOSTOMIDAE		
Carpoides cyprinus - Quillback (C & D Canal)	F	ST
Catostomus commersoni - White sucker (upper marsh crks)	F	R, SP (upper creeks)

TABLE 4 (cont.)

Species	Type of Species	Primary Activity in Area
Erimyzon oblongus - Creek chubsucker (upper marsh crks)	F	R, SP (upper creeks)
ICTALURIDAE - FRESHWATER CATFISHES		
Ictalurus catus - White catfish	F, B	R, SP
I. nebulosus - Brown bullhead	F, B	R, SP
I. punctatus - Channel catfish	F, B	R, SP
Noturus gyrinus - Tadpole madtom (upper Blackbird Crk)	F	R, SP (upper creeks)
BATRACHOIDIDAE - TOADFISHES		
Opsanus tau - Oyster toadfish	M, B	SF?
LOPHIIDAE - GOOSEFISHES		
Lophius americanus - Goosefish (dead on beach at Bayview)	M, B?	ST
GADIDAE - CODFISHES		
Enchelyopus cimbrius - Fourbeard rockling	M	ST
Gadus morhua - Atlantic cod	M	WF
Melanogrammus aeglefinus - haddock	M	WF
Merluccius bilinearis - Silver hake	M, B	
Pollachius virens - Pollock	M	
Urophycis chuss - Squirrel hake	M, B	
U. regius - Spotted hake	M, B	SF
U. tenuis - White hake	M, B	

TABLE 4 (cont.)

Species	Type of Species	Primary Activity in Area
EXOCOETIDAE - FLYINGFISHES AND HALFBEAKS		
Cypselurus heterurus - Atlantic flyingfish	M	ST
Hyporhamphus unifasciatus - Halfbeak (Lewes)	M, B	
BELONIDAE - NEEDLEFISHES		
Ablennes hians - Flat needlefish	M	
Hemiramphidae - Halfbeaks		
Hyporhamphus unifasciatus - Halfbeak	M	
Strongylura marina - Atlantic needlefish	M, B, F	N, SF
S. raphidoma - Houndfish	M	
CYPRINODONTIDAE - KILLIFISHES		
Cyprinodon variegatus - Sheepshead minnow	M, B, F	SF
Fundulus diaphanus - Banded killifish	F, B, M	R, SP
F. heteroclitus - Mummichog	B, F, M	R, SP
F. luciae - Spotfin killifish		
F. majalis - Striped killifish	M, B	SF
Lucania parva - Rainwater killifish	M, B	
POECILIIDAE - LIVEBEARERS		
Gambusia affinis - Mosquitofish	M, B, F	R, SP

TABLE 4 (Cont.)

Species	Type of Species	Primary Activity in Area
ATHERINIDAE - SILVERSIDES		
Membras martinica - Rough silverside	M, B, F	SF, SP?
Menidia beryllina - Tidewater silverside	B, F, M	R, SP
M. menidia - Atlantic silverside	M, B, F	R, SP
POLYMIXIIDAE - BEARDFISHES		
Polymixis lowei - Beardfish	M	ST
GASTEROSTEIDAE - STICKLEBACKS		
Apeltes quadracus - Fourspine stickleback	M, B, F	WF
Gasterosteus aculeatus - Threespine stickleback	M, B, F	WF
SYNGNATHIDAE - PIPEFISHES AND SEAHORSES		
Hippocampus erectus - Lined seahorse	M, B	ST
H. hudsonius - Lined seahorse	M, B	
H. obtusus - Offshore seahorse	M	ST
Syngnathus fuscus - Northern pipefish	M, B, F	N, SF
S. pelagicus - Sargassum pipefish	M	
CENTROPONIDAE - SNOOKS		
Centropomus undecimalis	M	
FISTULARIIDAE - CORNETFISHES		
Fistularia *tabacaria* - Cornetfish	M, B?	SF

TABL... 4(cont.)

Species	Type of Species	Primary Activity in Area
CENTRISCIDAE - SNIPEFISHES		
Macrorhamphosus scolopax - Longspine snipefish	M	SF
SEPRANIDAE - SEA BASSES		
Centropristes striatus - Black sea bass	M, B?	SF
Epinephelus niveatus - Snowy grouper	M	ST
CARANGIDAE - JACKS AND POMPANOS		
Caranx crysos - Blue runner	M	
C. hippos - Crevalle jack	M, B, F	N, SF
Decapterus macarellus - Mackeral scad	M	ST
C. punctatus - Round scad	M	ST
Selar crumenopthalmus - Big eye scad	M	
Selene vomer - Lookdown	M, B	ST
Seriola dumerili - Greater amberjack	M	ST
S. zonata - Banded rudderfish	M	ST
Trachinotus carolinus - Pompano	M	M, S, F
T. falcatus - Permit (Slaughter Beach, Lewes)	M	
Trachurus lathami - Rough scad	M	
Vomer setapinnis - Atlantic moonfish	M	

TABLE 4 (cont.)

Species	Type of Species	Primary Activity in Area
CORYPHAENIDAE - DOLPHINS		
Coryphaena hippurus - Dolphin	M	
POMADASYIDAE - GRUNTS		
Orthopristis chrysopterus - Pigfish	M	
SPARIDAE - PORGIES		
Lagodon rhomboides - Pinfish	M, B	ST
Stenotomus chrysops - Scup	M, B?	
EPHIPPIDAE - SPADEFISHES		
Chaetodipterus faber - Atlantic spadefish	M	ST
LUTJANIDAE - SNAPPERS		
Lutjanus griseus - Gray snapper	M, B, F	ST
Rhomboplites aurorubens - Vermilion snapper	M, B, F	ST
SCIAENIDAE - DRUMS		
Bairdiella chrysura - Silver perch	M, B, F	N, SF
Cynoscion regalis - Weakfish	M, B, F	N, SF
Leiostomus xanthurus - Spot	M, B, F	SF
Menticirrhus saxatilis - Northern kingfish	M, B	ST
Micropogon undulatus - Atlantic croaker	M, B, F	N, WF

TABL. 4(con..)

Species	Type of Species	Primary Activity in Area
Pogonias cromis - Black drum	M, B, F	N, SF
Sciaenops ocellata - Red drum	M, B, F?	
STROMATEIDAE - BUTTERFISHES		
Palinurichthys perciformis - Barrelfish	M	
Peprilus alepidotus - Harvestfish	M	
Poronotus triacanthus - Butterfish	M, B	SF
Psenes maculatus - Silver driftfish	M	
MUGILIDAE - MULLETS		
Mugil cephalus - Striped mulled	M, B, F	SF
M. curema - White mullet	M, B, F	ST
PHOLIDAE - GUNNELS		
Pholis gunnellus - Rock gunnel	M	
SPHYRAENIDAE - BARRACUDAS		
Sphyraena borealis - Northern sennet (Lewes)	M	
STICHAEIDAE - PRICKLEBACKS		
Ulvoria subbifurcata - Radiated shanny	M	
URANOSCOPIDAE - STARGAZERS		
Astroscopus y-graecum - Southern stargazer		
A. gut·tus - Northern stargazer	M, B	S

TABLE 4 (cont.)

Species	Type of Species	Primary Activity in Area
BLENNIIDAE - COMBTOOTH BLENNIES		
Chasmodes bosquianus - Striped blenny	M	
ANARHICHADIDAE		
Anarhichus lupus - Atlantic wolffish	M	ST
OPHIDIIDAE - CUSKEELS		
Rissola marginata - Striped Cuskeel	M, B	ST
ZOARCIDAE - EEL POUTS		
Macrozoarces americanus - Ocean pout	M	
GOBIIDAE - GOBIES		
Gobionellus boleosoma - Darter goby	M	
G. oceanicus - Highfin goby	M	
Gobiosoma bosci - Naked goby	M, B, F	N, SF
G. ginsburgi - Seaboard goby	N, B?	
Microgobius thalassinus - Green goby		
TRIGLIDAE - SEAROBINS		
Peristedion miniatum - Armored searobin	M	?SF
Prionotus carolinus - Northern searobin (off Bowers)	M	
P. evolans - Striped searobin	M, B	SF

TABLE 4 (cont.)

Species	Type of Species	Primary Activity in Area
COTTIDAE - SCULPINS		
<u>Hemitripterus</u> <u>americanus</u> - Sea raven	M	
<u>Myoxocephalus</u> <u>aenaeus</u> - Grubby		
<u>M.</u> <u>octodecem</u> <u>spinosus</u> - Long horn sculpin	M	
CYCLOPTERIDAE - LUMPFISHES AND SNAIL FISHES		
<u>Liparis</u> <u>liparis</u> - Striped Seasnail	M	ST
DACTYLOPTERIDAE - FLYING GURNARDS		
<u>Dactylop</u> <u>teridae</u> - Flying gurnard	M	
<u>Dactylopterus</u> <u>volitans</u> - Flying gurnard	M	ST
<u>Citharichthys</u> <u>spilopterus</u> - Bay whiff	M	
<u>Paralichthys</u> <u>oblongus</u> - Fourspot flounder	M, B	
AMMODYTIDAE - SAND LANCES		
<u>Ammodytes</u> <u>americanus</u> - American sand lance	M, B?	
CYNOGLOSSIDAE - TONGUEFISHES		
<u>Symphurus</u> <u>plagiusa</u> - Blackcheek tonguefish		
ECHENIDAE - REMORAS		
<u>Echeneis</u> <u>naucrates</u> - Sharksucker	M	ST
<u>Remora</u> <u>osteochir</u> - Marlin sucker	M	ST

TABLE ' (Cont.)

Species	Type of Species	Primary Activity in Area
R. remora - Remora	M	ST
BOTHIDAE - LEFTEYE FLOUNDER		
Citharichthys spilopterus - Bay Whiff	M	
Etropus grossotus - Fringed flounder		
E. microstomus - Smallmouth flounder	M, B	SF
Paralichthys dentatus - Summer flounder	M, B	SF
P. oblongus - Fourspot flounder	M, B	
Scophthalmus aquosus - Windowpane	M, B	SF
PLEURONECTIDAE - RIGHTEYE FLOUNDER		
Glyptocephalue cynoglossus - Witch flounder	M	
Limanda ferruginea - Yellowtail flounder	M, B	
Pseudopleuronectes americanus - Winter flounder	M, B, F	N, SF
SOLEIDAE - SOLES		
Trinectes maculatus - Hogchoker	M, B, F	N, SF
CHAETODONTIDAE - BUTTERFLY FISHES		
Chaetodon ocellatus	M	
Holacanthus bermudensis - Blue anglefish	M	
H. ciliaris - Queen angelfish	M	

TABL 4(cont.)

Species	Type of Species	Primary Activity in Area
LABRIDAE - WRASSES		
Tautoga onitis - Tautog	M	SP
Tautogolabrus adspersus - Cunner	M	
SCARIDAE - PARROT FISHES		
Scarus guacamaia	M	
TRICHIURIDAE - CUTLASS FISHES		
Trichiurus lepturus - Atlantic cutlass fish	M	
SCOMBRIDAE - MACKERALS AND TUNAS		
Acanthocybium solanderi - Wahoo	M	
Scomber japonicus - Chub mackeral	M	
Scomberomorus cavalla - King mackeral	M	
Thunnus alalunga - Albacore	M	
T. thynnus - Bluefin tuna	M	
Euthynnus alletteratus - Little tuna		
Sarda sarda - Atlantic bonito	M	
Scomber scombrus - Atlantic mackeral	M, B	
ISTIOPHORIDAE - BILLFISHES		
Makaira albida - White marlin	M	ST

TABLE 4 (cont.)

Species	Type of Species	Primary Activity in Area
M. nigricans - Blue marlin	M	ST
XIPHIIDAE - SWORDFISHES		
Xiphias gladius - Swordfishes	M	ST
BALISTIDAE - TRIGGERFISHES AND FILEFISHES		
Aluterus schoepfi - Orange filefish (dead in river)	M, B?	ST
Balistes capriscus - Gray triggerfish	M	
Monacanthus hispidus - Planehead filefish	M	
TETRAODONTIDAE - PUFFERS		
Lagocephalus laevitagus - Smooth puffer	M	
Sphaeroides maculatus - Northern puffer	M, B	ST
PERCICHTHYIDAE - TEMPERATE BASSES		
Morone americana - White perch	B, F, M	R, 3P
M. saxatilis - Striped bass	M, B, F	M (adults), R?, N, SF
PRIACANTHIDAE - BIG EYES		
Pristigenys alta - Short big eye	M, B	
CENTRARCHIDAE - SUNFISHES		
Enneacanthus chaetodon - Blackbanded sunfish (C & D Canal)	F	ST

TABI 4(cont.)

Species	Type of Species	Primary Activity in Are.
Lepomis auritus - Redbreast sunfish (upper Blackbird Creek)	F	R, SP (upper cre
L. gibbosus - Pumpkinseed	F, B	R, SP
L. macrochirus - Bluegill	F, B	R, SP (in creek la
Micropterus salmoides - Largemouth bass	F, B	R, SP (in creek la
Pomoxis annularis - White crappie	F, B	R, SP
P. nigromaculatus - Black crappie	F, B	R, SP
PERCIDAE - PERCHES		
Etheostoma fusiforme	F, B	
E. olmstedi - Tessellated darter	F, B	R, SP
Perca flavescens - Yellow perch	F, B	R, SP
POMATOMIDAE - BLUEFISHES		
Pomatomus saltatrix - Bluefish	M, B, F	M, SP
DIODONTIDAE - PORCUPINE FISHES		
Chilomycterus schoepfi - Striped Burrfish	M	
OSTRACIIDAE		
Ostracion diaphanum - Spiny boxfish	M, B	
MOLIDAE		
Mola - Ocean sunfish	M	SP

TABLE 5 List of fishes collected from the Delaware River and four marsh creeks in the vicinity of Artificial Island in June, 1968, to January, 1971. Those species taken outside of, but adjacent to, the study area have the locality noted in parentheses after the common name. Type of species: M = Marine; B = Brackish (Sal. 1-10 ppt); F = Fresh. Primary activity in area: M = Migrant; SP = Spawning in Area; SF = Summer Feeding; WF = Winter Feeding; N = Nursery; R = Resident Species; ST = Stray.

Species	Type of Species	Primary Activity in Area
PETROMYZONTIDAE - LAMPREYS		
Petromyzon marinus-Sea lamprey	M, B, F	M
CARCHARHINIDAE - REQUIEM SHARKS		
Sandbar shark		
Carcharhinus obscurus-Dusky shark	M	ST
Mustelus canis-Smooth dogfish (Lewes)	M	
DASYATIDAE - STINGRAYS		
Dasyatis sabina-Atlantic stingray (off Bowers)	M	
MYLIOBATIDAE - EAGLE RAYS		
Rhinoptera bonasus-Cownose ray	M	ST
ACIPENSERIDAE - STURGEONS		
Acipenser oxyrhyncus-Atlantic sturgeon	M, B, F	M
ANGUILLIDAE - FRESHWATER EELS		
Anguilla rostrata-American eel	M, B, F	M, SF, N, R
CLUPEIDAE - HERRINGS		
Alosa aestivalis-Blueback herring	M, B, F	SP, N
Alosa mediocris-Hickory shad	M, B, F	M (adults), SF (young)
Alosa pseudoharengus-Alewife	M, B, F	SP, N
Alosa sapidissima-American shad	M, B, F	M
Brevoortia tyrannus-Atlantic menhaden	M, B, F	N, SF
Dorosoma cepedianum-Gizzard shad	F, B	R, SP

(Thomas 1971)

TABLE 5 continued

Species	Type of Species	Primary Activity in Area
ENGRAULIDAE - ANCHOVIES		
Anchoa hepsetus-Striped anchovy	M, B	ST
Anchoa mitchilli-Bay anchovy	M, B, F	SP?, N, SF
UMBRIDAE - MUDMINNOWS		
Umbra pygmacea-Eastern mudminnow	F	ST
ESOCIDAE - PIKES		
Esox americanus-Redfin pickerel	F, B	R, SP
Esox niger-Chain pickerel	F, B	R, SP
CYPRINIDAE - MINNOWS AND CARPS		
Carassius auratus-Goldfish	F, B	R, SP?
Cyprinus carpio-Carp	F, B	R, SP
Hybognathus nuchalis-Silvery minnow	F, B	R, SP
Notemigonus crysoleucas-Golden shiner	F, B	R, SP
Notropis analostanus-Satinfin shiner	F	R, SP (upper crk. lakes)
Notropis hudsonius-Spottail shiner	F, B	R, SP
Rhinichthys atratulus-Blacknose dace	F	ST
CATOSTOMIDAE		
Carpoides cyprinus-Quillback (C&D Canal)	F	ST
Catostomus commersoni-White sucker (upper marsh crks.)	F	R, SP (upper creeks)
Erimyzon oblongus-Creek chubsucker (upper marsh crks.)	F	R, SP (upper creeks)
ICTALURIDAE - FRESHWATER CATFISHES		
Ictalurus catus-White catfish	F, B	R, SP
Ictalurus nebulosus-Brown bullhead	F, B	R, SP
Ictalurus punctatus-Channel catfish	F, B	R, SP
Noturus gyrinus-Tadpole madtom (upper Blackbird Crk.)	F	R, SP (upper creeks)
BATRACHOIDIDAE - TOADFISHES		
Opsanus tau-Oyster toadfish	M, B	SF?

(Th. mas 1971)

TABLE 5 continued

Species	Type of Species	Primary Activity in Area
LOPHIIDAE - GOOSEFISHES		
Lophius americanus-Goosefish (Dead on beach at Bayview)	M, B?	ST
GADIDAE - CODFISHES		
Urophycis regius-Spotted hake	M, B	SF
OPHIDIIDAE - CUSK-EELS AND BROTULAS		
Rissola marginata-Striped cusk-eel	M, B	ST
EXOCOETIDAE - FLYINGFISHES AND HALFBEAKS		
Hyporhamphus unifasciatus-Halfbeak (Lewes)	M	
BELONIDAE - NEEDLEFISHES		
Strongylura marina-Atlantic needlefish	M, B, F	N, SF
CYPRINODONTIDAE - KILLIFISHES		
Cyprinodon variegatus-Sheepshead minnow	M, B, F	SF
Fundulus diaphanus-Banded Killifish	F, B, M	R, SP
Fundulus heteroclitus-Mummichog	B, F, M	R, SP
Fundulus majalis-Striped Killifish	M, B	SF
POECILIIDAE - LIVEBEARERS		
Gambusia affinis-Mosquitofish	M, B, F	R, SP
ATHERINIDAE - SILVERSIDES		
Membras martinica-Rough silverside	M, B, F	SF, SP?
Menidia beryllina-Tidewater silverside	B, F, M	R, SP
Menidia menidia-Atlantic silverside	M, B, F	R, SP
GASTEROSTEIDAE - STICKLEBACKS		
Apeltes quadracus-Fourspine stickleback	M, B, F	WF
Gasterosteus aculeatus-Threespine stickleback	M, B, F	WF

(Thomas 1971)

TABLE 5 continued

Species	Type of Species	Primary Activity in Area
SYNGNATHIDAE - PIPEFISHES AND SEAHORSES		
Hippocampus erectus -Lined seahorse	M, B	ST
Syngnathus fuscus-Northern pipefish	M, B, F	N, SF
PERCICHTHYIDAE - TEMPERATE BASSES		
Morone americana-White perch	B, F, M	R, SP
Morone saxatilis-Striped bass	M, B, F	M (adults), R?, N, SF
CENTRARCHIDAE - SUNFISHES		
Enneacanthus chaetodon-Blackbanded sunfish (C&D Canal)	F	ST
Lepomis auritus-Redbreast sunfish (upper Blackbird Creek)	F	R, SP (upper creeks)
Lepomis gibbosus-Pumpkinseed	F, B	R, SP
Lepomis macrochirus-Bluegill	F, B	R, SP (in creek lakes)
Micropterus salmoides-Largemouth bass	F, B	R, SP (in creek lakes)
Pomoxis annularis-White crappie	F, B	R, SP
Pomoxis nigromaculatus-Black crappie	F, B	R, SP
PERCIDAE - PERCHES		
Etheostoma olmstedi-Tessellated darter	F, B	R, SP
Perca flavescens-Yellow perch	F, B	R, SP
POMATOMIDAE - BLUEFISHES		
Pomatomus saltatrix-Bluefish	M, B, F	N, SF
CARANGIDAE - JACKS AND POMPANOS		
Caranx hippos-Crevalle jack	M, B, F	N, SF
Selene vomer-Lookdown	M, B	ST
Trachinotus carolinus-Florida pompano (Slaughter Beach, Lewes)	M	
Trachinotus falcatus-Permit (Slaughter Beach, Lewes)	M	
Vomer setapinnis-Atlantic moonfish	M	
LUTJANIDAE - SNAPPERS		
Lutjanus griseus-Gray snapper	M, B, F	ST

(Thomas 1971)

TABLE 5 continued

Species	Type of Species	Primary Activity in Area
SPARIDAE - PORGIES		
Lagodon rhomboides-Pinfish (Woodland Beach)	M, B	ST
SCIAENIDAE - DRUMS		
Bairdiella chrysura-Silver perch	M, B, F	N, SF
Cynoscion regalis-Weakfish	M, B, F	N, SF
Leiostomus xanthurus-Spot	M, B, F	SF
Menticirrhus saxatilis-Northern kingfish	M, B	ST
Micropogon undulatus-Atlantic croaker	M, B, F	N, WF
Pogonias cromis-Black drum	M, B, F	N, SF
MUGILIDAE - MULLETS		
Mugil cephalus-Striped mullet	M, B, F	SF
Mugil curema-White mullet	M, B, F	ST
SPHYRAENIDAE - BARRACUDAS		
Sphyraena borealis-Northern sennet (Lewes)	M	
URANOSCOPIDAE - STARGAZERS		
Astroscopus guttatus-Northern stargazer	M, B	ST
GOBIIDAE - GOBIES		
Gobiosoma bosci-Naked goby	M, B, F	N, SF
STROMATEIDAE - BUTTERFISHES		
Peprilus triacanthus-Butterfish	M, B	SF
TRIGLIDAE - SEAROBINS		
Prionotus carolinus-Northern searobin (off Bowers)	M	
Prionotus evolans-Striped searobin	M, B	SF

(Thomas 1971)

TABLE 5 continued

Species	Type of Species	Primary Activity in Area
BOTHIDAE - LEFTEYE FLOUNDER		
Etropus microstomus-Smallmouth flounder	M, B	ST
Paralichthys dentatus-Summer flounder	M, B	ST
Scophthalmus aquosus-Windowpane	M, B	ST
PLEURONECTIDAE - RIGHTEYE FLOUNDER		
Pseudopleuronectes americanus-Winter flounder	M, B, F	N, SF
SOLEIDAE - SOLES		
Trinectes maculatus-Hogchoker	M, B, F	N, SF
BALISTIDAE - TRIGGERFISHES AND FILEFISHES		
Aluterus schoepfi-Orange filefish (Dead in river)	M, B?	ST
TETRAODONTIDAE - PUFFERS		
Sphaeroides maculatus-Northern puffer	M, B	ST

(Thomas 1971)

TABLE 6 Fish catch composition in Delaware Bay by years and for the total sampling period. 1966 was only sampled from August through December.

Species	YEARS 1966 #	1966 %	1967 #	1967 %	1968 #	1968 %	1969 #	1969 %	1970 #	1970 %	Total Period #	Total Period %
Sand Shark	2	0.01	14	0.04	3	0.01	2	0.01	1	0.01	22	0.02
Sandbar Shark	14	0.04	37	0.10	1	0.00	4	0.02	4	0.02	60	0.04
Smooth Dogfish	652	1.83	799	2.09	637	2.85	605	2.74	643	2.74	643	3.61
Spiny Dogfish	84	0.24	125	0.33	51	0.23	49	0.22	105	0.59	414	0.30
Atlantic Angel Shark	1	0.00	-	-	2	0.01	-	-	1	0.01	4	0.00
Clearnose Skate	592	1.66	1087	2.84	352	1.57	231	1.04	109	0.61	2371	1.74
Little Skate	19	0.05	49	0.13	63	0.28	34	0.15	52	0.29	217	0.16
Winter Skate	-	-	29	0.08	2	0.01	-	-	1	0.01	32	0.02
Roughtail Stingray	77	0.22	81	0.21	112	0.50	158	0.71	138	0.78	566	0.42
Bluntnose Stingray	66	0.19	72	0.19	4	0.02	7	0.03	82	0.46	231	0.17
Smooth Butterfly Ray	-	-	2	0.01	-	-	6	0.03	-	-	8	0.01
Spiny Butterfly Ray	6	0.02	-	-	3	0.01	1	0.00	1	0.01	11	0.01
Bullnose Ray	54	0.15	123	0.32	72	0.32	102	0.46	104	0.58	455	0.33
Cownose Ray	-	-	-	-	-	-	44	0.20	-	-	44	0.03
Atlantic Sturgeon	2	0.01	-	-	-	-	-	-	-	-	2	0.00
Blueback Herring	-	-	5	0.01	5	0.02	-	-	9	0.05	19	0.01
Hickory Shad	-	-	45	0.12	1	0.00	-	-	6	0.03	52	0.04
Alewife	21	0.06	59	0.15	27	0.12	15	0.07	19	0.11	141	0.10
Atlantic Menhaden	-	-	23	0.06	23	0.10	11	0.05	13	0.07	70	0.05
Atlantic Herring	1	0.00	464	1.21	344	1.54	350	1.58	88	0.49	1247	0.92
Gizzard Shad	-	-	4	0.01	4	0.02	-	-	-	-	8	0.01
Striped Anchovey	1	0.00	8	0.02	2	0.01	-	-	14	0.08	25	0.02
Bay Anchovey	24	0.07	1	0.00	1	0.00	4	0.02	7	0.04	37	0.03
Conger Eel	1	0.00	-	-	-	-	-	-	1	0.01	2	0.00
Striped Killifish	-	-	-	-	1	0.00	-	-	-	-	1	0.00
Silver Hake	41	0.12	549	1.44	481	2.15	69	0.31	27	0.15	1167	0.86
Squirrel Hake	89	0.25	838	2.19	145	0.65	38	0.17	58	0.33	1168	0.86
Spotted Hake	48	0.13	1311	3.43	471	2.10	81	0.37	266	1.50	2177	1.60
Threespine Stickleback	-	-	-	-	2	0.01	-	-	-	-	2	0.00
Black Seabass	5	0.01	10	0.03	5	0.02	23	0.10	18	0.10	61	0.04
White Perch	113	0.32	485	1.27	750	3.35	6	0.03	17	0.10	1371	1.01

TABLE 6 (cont.)

Species	1966 #	1966 %	1967 #	1967 %	1968 #	1968 %	1969 #	1969 %	1970 #	1970 %	Total Period #	Total Period %
Striped Bass	1	0.00	58	0.15	82	0.37	1	0.00	11	0.06	153	0.11
Snowy Grouper	-	-	-	-	-	-	1	0.00	-	-	1	0.00
Bluefish	20	0.06	7	0.02	2	0.01	3	0.01	11	0.06	43	0.03
Blue Runner	-	-	2	0.01	4	0.02	2	0.01	-	-	8	0.01
Lookdown	-	-	5	0.01	-	-	3	0.01	1	0.01	9	0.01
Pig Fish	3	0.01	2	0.01	-	-	-	-	3	0.02	8	0.01
Silver Perch	137	0.39	24	0.06	13	0.06	47	0.21	224	1.26	445	0.33
Weakfish	11315	31.82	10572	27.64	6083	27.18	7841	35.46	6464	36.34	42275	31.06
Northern Kingfish	136	0.38	119	0.31	117	0.52	65	0.29	63	0.35	500	0.37
Spot	1731	4.87	4	0.01	-	-	1683	7.61	76	0.43	3494	2.57
Black Drum	1838	5.17	79	0.21	10	0.04	143	0.65	116	0.65	2186	1.61
Atlantic Croaker	-	-	-	-	-	-	-	-	4	0.02	4	0.00
Scup	5253	14.77	9650	25.23	593	2.65	445	2.01	1699	9.55	17640	12.96
Tautog	2	0.01	19	0.05	1	0.00	8	0.04	5	0.03	35	0.03
Northern Searobin	808	2.27	2225	5.82	1009	4.51	585	2.65	405	2.28	5032	3.70
Striped Searobin	106	0.30	303	0.79	159	0.71	158	0.71	324	1.82	1050	0.77
Sea Raven	-	-	1	0.00	-	-	-	-	-	-	1	0.00
Grubby	-	-	-	-	5	0.02	-	-	1	0.01	6	0.00
Longhorn Sculpin	6	0.02	495	1.29	1330	5.94	403	1.82	251	1.41	2485	1.83
Sea Snail	-	-	-	-	1	0.00	1	0.00	-	-	2	0.00
Northern Stargazer	22	0.06	2	0.01	-	-	1	0.00	-	-	25	0.02
Ocean Pout	-	-	-	-	10	0.04	7	0.03	7	0.04	24	0.02
Striped Cusk-Eel	-	-	-	-	13	0.06	-	-	-	-	13	0.01
Butterfish	52	0.15	1115	2.91	371	1.66	17	0.08	310	1.74	1865	1.37
Striped Mullet	-	-	-	-	-	-	1	0.00	1	0.01	2	0.00
Fringed Flounder	20	0.06	29	0.08	82	0.37	10	0.05	26	0.15	167	0.12
Summer Flounder	219	0.62	161	0.42	88	0.39	135	0.61	61	0.34	664	0.49
Fourspot Flounder	5	0.01	3	0.01	8	0.04	3	0.01	2	0.01	21	0.02
Windowpane	1087	3.06	1534	4.01	1619	7.23	964	4.36	827	4.65	6031	4.43
Winter Flounder	5	0.01	277	0.72	188	0.84	69	0.31	74	0.42	613	0.45
Hogchoker	8565	24.09	4522	11.82	6391	28.56	6778	30.65	4628	26.02	30884	22.69
Orange Filefish	1	0.00	1	0.00	-	-	1	0.00	8	0.04	11	0.01
Planehead Filefish	-	-	-	-	1	0.00	1	0.00	-	-	2	0.00

TABLE 6 (cont.)

Species	1966 #	1966 %	1967 #	1967 %	1968 #	1968 %	1969 #	1969 %	1970 #	1970 %	Total Period #	Total Period %
Northern Puffer	842	2.37	563	1.47	581	2.60	427	1.93	125	0.70	2538	1.86
Striped Burrfish	8	0.02	3	0.01	4	0.02	9	0.04	2	0.01	26	0.02
Oyster Toadfish	1465	4.12	248	0.65	47	0.21	459	2.08	271	1.52	2490	1.83
Goosefish	1	0.00	8	0.02	3	0.01	4	0.02	3	0.02	19	0.01
TOTAL	35561	100.00	38251	100.00	22379	100.00	22115	100.00	17787	100.00	136093	100.00

(Daiber and Smith 1971)

TABLE 7 Streams Known to Have Anadromous Clupeid Spawning Runs in Salem, Cumberland and Cape May Counties, New Jersey

Gloucester and Salem Counties - Delaware River Drainage

Oldmans Creek-alewife

Salem County-Delaware River Drainage

Beaver Creek-alewife - Oldmans Creek Drainage
Fenwick Creek-alewife - Salem River Drainage
Mannington Creek-alewife - Salem River Drainage
Salem River-alewife
Deep Run-alewife - Alloway Creek Drainage
Buckshutem Creek-alewife - Maurice River Drainage
Menantico Creek-alewife - Maurice River Drainage
Greenies Sandwash-alewife - Maurice River Drainage
Hankins Brook-alewife - Maurice River Drainage
White Marsh Run-alewife - Maurice River Drainage
Maurice River-blueback
Raceway-alewife - Maurice River Drainage
Maurice River-alewife

Cumberland and Cape May Counties-Delaware Bay Drainage

West Creek-alewife - Delaware Bay Drainage
Alloway Creek-alewife

Salem and Cumberland Counties-Delaware River Drive

Raccoon Ditch-alewife - Stow Creek Drainage
Stow Creek-alewife
Mill Creek-blueback - Cohansey River Drainage
Mill Creek-alewife - Cohansey River Drainage
Cohansey River-blueback
Cohansey River-alewife
Cedar Creek-blueback
Cedar Creek-alewife
Muskee Creek-alewife - Maurice River Drainage
Manumuskin River-alewife - Maurice River Drainage

Table 8

List of species obtained from transect samples
in Delaware Bay during 1972 and 1973

	Feeding* Type	Transects 1-13	Transects 14-26
Phylum Cnidaria			
Class Hydrozoa			
Order Hydroida			
Family Hydractiniidae			
Hydractinia echinata (Fleming 1828)	SF		x
Family Campanulariidae			
Hartlaubella gelatinosa (Pallas 1766)	SF	x	
Family Sertulariidae			
Sertularia argentea Linne 1758	SF	x	
Family Plumulariidae			
Schizotricha tenella (Verrill 1874)	SF	x	
Class Anthozoa			
Order Actinaria			
Family Diadumenidae			
Diadumene leucolena (Verrill 1866)	SF	x	
Phylum Rhynchocoela			
Class Anopla			
Order Heteronemertini			
Family Lineidae			
Cerebratulus lacteus (Leidy 1851)	C	x	x
Micrura leidyi	C	x	
Class Unknown			
Nemertea sp.	C	x	x
Phylum Annelida			
Family Ampharetidae			
Asabellides oculatus (Webster 1879)	DF	x	x
Melinna sp. cf. M. maculata	DF	x	
Asabellides sp. cf. A. oculatus	DF	x	
? Asabellides	DF		x
Ampharetidae sp. 1	DF		x
Family Arabellidae			
Arabella iricolor (Montagu 1804)	O		x
Drilonereis longa Webster 1879	O	x	x
Drilonereis magna Webster and Benedict 1887	O		x
Family Capitellidae			
Capitella capitata (Fabricius 1780)	DF	x	x
Heteromastus filiformis (Claparede 1864)	DF	x	x

Table 8 (cont.)

	Feeding Type	Transects 1-13	Transects 14-26
Family Cirratulidae			
Caulleriella sp. 2	DF		x
Tharyx sp. 2	DF	x	x
Cirriformia sp. cf. *C. grandis*	DF	x	
? *Chaetozone*	DF		x
Family Eunicidae			
Marphysa sanguinea (Montagu 1815)	DF		x
Family Glyceridae			
Glycera americana Leidy 1855	C	x	x
Glycera capitata Oersted 1843	C		x
Glycera dibranchiata Ehlers 1868	C	x	x
Glycera robusta Ehlers 1868	C	x	
Family Goniadidae			
Glycinde solitaria (Webster 1880)	C	x	x
Family Hesionidae			
Microphthalmus aberrans (Webster and Benedict 1887)	C		x
Family Lumbrineridae			
Lumbrineris acuta (Verrill 1875)	DF	x	
Lumbrineris tenuis (Verrill 1873)	DF	x	x
Lumbrineris sp. cf. *L. tenuis* (Verrill 1873)	DF	x	
Family Magelonidae			
Magelona sp. 1	DF	x	
Magelona sp. 2	DF		x
Magelona sp. 4	DF	x	
Family Maldanidae			
Clymenella sp. cf. *C. torquata* (Leidy 1855)	DF	x	
Family Nephtyidae			
Nephtys bucera Ehlers 1868	O		x
Nephtys picta Ehlers 1868	O	x	x
Family Nereidae			
Nereis (*Neanthes*) *succinea* Frey and Leuckart 1847	O	x	x
Family Opheliidae			
Ophelia bicornis Savigny 1818	DF		x
Travisia carnea Verrill 1873	DF		x
Family Orbiniidae			
Haploscoloplos acutus (Verrill 1873)	DF		x
Haploscoloplos fragilis (Verrill 1873)	DF	x	x
Haploscoloplos robustus (Verrill 1873)	DF	x	x
Orbinia ornatus (Verrill 1873)	DF	x	
Scoloplos sp.	DF	x	
Family Paraonidae			
Aricidea sp.	DF		x
Aricidea cerruti Laubier 1967	DF		x
Paradoneis (*Paraoinides*) *lyra* Southern 1914	DF	x	

Table 8 (cont.)

	Feeding Type	Transects 1-13	Transects 14-26
Family Pectinariidae			
Pectinaria gouldii Verrill 1873	DF	x	
Family Phyllodocidae			
Eteone heteropoda Hartman 1951	O	x	x
Eteone lactea Claparede 1868	O		x
Eteone longa (Fabricius 1780)	O		x
Eumida sanguinea (Oersted 1843)	O	x	
Paranaitis kosteriensis (Malmgren 1867)	C		x
Phyllodoce arenae Webster 1880	C		x
Family Polynoidae			
Harmothoe sp. cf. H. extenuata (Grube 1840)	C	x	
Harmothoe (Lagisca) extenuata (Grube 1840)	C	x	x
Lepidonotus squamatus (Linnaeus 1756)	C		x
Lepidonotus sublevis Verrill 1873	C	x	x
Family Sabellaridae			
Sabellaria vulgaris Verrill 1873	SF	x	x
Family Sabellidae			
Potamilla reniformis (Leuchart 1849)	SF		x
Family Serpulidae			
Hydroides dianthus (Verrill 1873)	SF		x
Family Sigalionidae			
Sthenelais (denticulatum)	C	x	
Sigalion sp.	C	x	
Family Spionidae			
Polydora ligni Webster 1879	DF	x	x
Polydora socialis (Schmarda 1861)	DF		x
Polydora websteri Hartman 1943	DF		x
Scolecolepides viridis (Verrill 1873)	DF	x	x
Scolelepis squamata (O.F. Muller 1806)	DF		x
Spiophanes bombyx (Claparede 1870)	DF	x	x
Streblospio benedicti Webster 1879	DF	x	x
Family Syllidae			
Exogone verugera (Claparede 1868)	O	x	
Parapionosyllis longicirrata Webster and Benedict 1884)	O		x
Proceraea cornuta (Agassiz 1863)	O		x
Family Terebellidae			
Polycirrus eximius (Leidy 1855)	DF		x
Class Oligochaeta			
Oligochaeta	DF	x	
Phylum Mollusca			
Class Gastropoda			
Order Mesogastropoda			
Family Epitoniidae			
Epitonium rupicola (Kurtz 1860)	C	x	
Family Calyptraeidae			
Crepidula fornicata (Linne 1758)	SF		x
Crepidula convexa Say 1822	SF	x	x
Crepidula plana Say 1822	SF		x

Table 8 (cont.)

	Feeding Type	Transects 1-13	Transects 14-26
Family Naticacea			
Lunatia heros (Say 1822)	C		x
Order Neogastropoda			
Family Melongenidae			
Busycon carica (Gmelin 1791)	C		x
Family Nassariidae			
Nassarius trivittatus (Say 1822)	C	x	x
Ilyanassa obsoletus (Say 1822)	C	x	x
Family Marginellidae			
Marginella roscida Redfield 1860	C	x	
Order Tectibranchia			
Family Pyramidellidae			
Sayella fusca (C.B. Adams 1839)	ectoparasitic		x
Order Nudibranchia			
Family Corambella			
Dorodella obscura Verrill 1870	C	x	x
Class Bivalvia			
Order Protobranchia			
Family Nuculidae			
Nucula proxima Say 1822	DF	x	x
Yoldia limatula Say 1831	DF	x	x
Order Filibranchia			
Family Arcidae			
Anadara ovalis (Bruguiere 1789)	SF		x
Family Mytilidae			
Geukensia demissa (Dillwyn 1817)	SF		x
Mytilus edulis Linne 1758	SF		x
Family Ostreidae			
Crassostrea virginica (Gmelin 1791)	SF	x	x
Order Eulamellibranchia			
Family Carditidae			
Cyclocardia borealis (Conrad 1831)	SF	x	
Family Leptonidae			
Mysella planulata (Stimpson 1857)	SF		x
Family Veneridae			
Mercenaria mercenaria (Linne 1758)	SF	x	x
Gemma gemma (Totten 1834)	SF	x	x
Family Tellinidae			
Tellina agilis Stimpson 1857	DF	x	x
Macoma balthica (Linne 1758)	DF	x	x
Family Solenidae			
Ensis directus Conrad 1843	SF	x	x
Family Mactridae			
Spisula solidissima (Dillwyn 1817)	SF	x	x
Mulinia lateralis (Say 1822)	SF	x	x
Family Myacidae			
Mya arenaria Linne 1758	SF	x	x

Table 8 (cont.)

	Feeding Type	Transects 1-13	Transects 14-26
Family Corbulidae			
Corbula contracta Say 1822	SF	x	x
Family Lyonsiidae			
Lyonsia hyalina Conrad 1831	SF	x	x
Family Pandoridae			
Pandora gouldiana Dall 1886	SF		x
Phylum Arthropoda			
Class Merostomata			
Limulus polyphemus (Linne 1758)	C		x
Class Pycnogonida			
Family Pallenidae			
Tanystylum orbiculare Wilson 1878	DF	x	x
Class Crustacea			
Subclass Cirripedia			
Order Thoracica			
Family Balanidae			
Balanus (Balanus) improvisus Darwin 1854	SF		x
Balanus (Semibalanus) balanoides (Linne)	SF		x
Subclass Malacostraca			
Order Mysidacea			
Family Mysidae			
Neomysis americana (S.I. Smith 1873)	SF	x	x
Order Cumacea			
Family Diastylidae			
Oxyurostylis smithi Calman 1912	DF		x
Order Isopoda			
Family Anthuridae			
Cyathura polita (Stimpson 1855)	O	x	x
Ptilanthura tenuis Harger 1878	O		x
Cyathura burbancki Frankenberg 1965	O		x
Family Idoteidae			
Chiridotea nigrescens Wigley 1961	DF		x
Edotea triloba (Say 1818)	DF		x
Order Amphipoda			
Family Ampeliscidae			
Ampelisca abdita Mills 1964	DF	x	x
Ampelisca verrilli Mills 1967	DF	x	x
Family Ampithoidae			
Ampithoidae sp.	DF	x	
Family Aoridae			
Lembos smithi (Holmes 1905)	DF		x
Family Bateidae			
Batea catharinensis Fr. Muller 1865	DF	x	
Family Corophiidae			
Corophium insidiosum Crawford 1937	DF	x	x
Corophium lacustre Vanhoffen 1911	DF	x	
Corophium tuberculatum Shoemaker 1934	DF	x	x
Erichthonius brasiliensis Dana 1853	DF	x	x

Table 8 (cont.)

	Feeding Type	Transects 1-13	14-26
Family Corophiidae (cont.)			
Unciola irrorata Say 1818	DF	x	
Unciola serrata Shoemaker 1945	DF	x	x
Unciola dissimilis Shoemaker 1945	DF	x	
Corophium simile Shoemaker 1934	DF	x	x
Family Gammaridae			
Gammarus mucronatus Say 1818	DF	x	x
Elasmopus laevis (Smith 1871)	DF		x
Melita nitida Smith 1873	DF	x	x
Family Haustoriidae			
Parahaustorius attenuatus Bousfield 1965	DF	x	
Parahaustorius longimerus Bousfield 1965	DF	x	
Protohaustorius wigleyi Bousfield 1965	DF	x	x
Protohaustorius deichmannae Bousfield 1965	DF	x	
Acanthohaustorius millsi Bousfield 1965	DF	x	x
Acanthohaustorius intermedius Bousfield 1965	DF		x
Family Lysianassidae			
Lysianopsis alba Holmes 1905	DF	x	
Family Phoxocephalidae			
Paraphoxus spinosus Holmes 1903	DF		x
Trichophoxus epistomus (Shoemaker 1938)	DF	x	
Family Pleustidae			
Parapleustes aestuarius Watling and Maurer 1973	DF	x	x
Family Stenothoidae			
Parametopella cypris (Holmes 1905)	DF		x
Family Caprellidae			
Paracaprella tenuis Mayer 1903	SF	x	x
Order Decapoda			
Family Crangonidae			
Crangon septemspinosa (Say 1818)	DF	x	x
Family Callianassidae			
Callianassa sp. cf. *C. atlantica*	DF	x	
Family Paguridae			
Pagurus longicarpus Say 1817	DF	x	x
Family Cancridae			
Cancer irroratus Say 1817	C	x	x
Family Xanthidae			
Xanthid sp.	C	x	
Eurypanopeus depressus (Smith 1869)	C	x	x
Neopanope texana sayi (Smith 1869)	C	x	x
Rhithropanopeus harrisi (Gould 1841)	C		x
Family Pinnotheridae			
Pinnotheres maculatus Say 1818	commensal		x
Pinnixa sayana Stimpson 1860	DF	x	x

Table 8 (cont.)

	Feeding Type	Transects 1-13	Transects 14-26
Phylum Ectoprocta			
Class Gymnolaemata			
Order Ctenostomata			
Family Alcyonidiidae			
Alcyonidium polyoum (Hassall 1841)	SF	x	x
Alcyonidium verrilli Osburn 1912	SF		x
Family Nolellidae			
Anguinella palmata Van Beneden 1844	SF	x	
Family Flustrellidae			
Flustrellidra hispida (Fabricius 1780)	SF	x	
Family Vesiculariidae			
Bowerbankia gracilis Leidy 1855	SF	x	
Family Triticellidae			
Triticella elongata (Osburn 1912)	SF	x	
Order Cheilostomata			
Family Membraniporidae			
Membranipora tenuis Desor 1848	SF	x	x
Membranipora tuberculata (Bosc 1802)	SF		x
Conopeum tenuissimum (Canu 1908)	SF	x	x
Family Electridae			
Electra hastingsae Marcus 1938	SF	x	x
Family Schizoporellidae			
Schizoporella errata (Watess 1878)	SF		x
Family Microporellidae			
Microporella ciliata (Pallas 1766)	SF		x
Phylum Echinodermata			
Class Echinoidea			
Order Diadematoida			
Family Echinarachnidae			
Echinarachnius parma (Lamark 1816)	SF		x

Source: Watling, Maurer and Wethe, 1976

*SF = Suspension Feeder
DF = Deposit Feeder
C = Carnivore
O = Omnivore

Table 9 Commercial Fish and Shellfish Landings in Delaware Bay and River, 1955-1977*

	New Jersey		Delaware		Total	
Year	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars
1955	6,027,125	2,611,829	6,359,700	1,290,374	12,386,825	3,902,203
1956	6,229,300	2,963,116	6,280,700	1,182,417	12,510,000	4,145,533
1957	4,364,100	1,874,694	10,035,500	3,890,741	14,399,600	5,765,435
1958	2,437,200	664,939	N/A	N/A	-	-
1959	1,507,040	277,194	N/A	N/A	-	-
1960	2,076,700	294,928	2,622,250	383,940	4,698,950	678,868
1961	3,267,200	967,519	1,511,400	257,001	4,778,600	1,224,520
1962	3,109,000	1,545,010	2,647,800	317,431	5,756,800	1,862,441
1963	2,188,100	658,494	1,036,900	161,243	2,846,594	819,737
1964	2,489,700	1,087,365	911,400	183,972	3,401,100	1,271,337
1965	2,133,700	767,541	994,400	122,468	3,128,100	890,009
1966	1,858,500	839,873	841,500	89,593	2,700,000	929,466
1967	2,444,300	1,080,500	449,800	82,798	2,893,800	1,163,298
1968	1,934,100	1,091,083	396,300	98,147	2,330,400	1,189,230
1969	1,874,100	889,716	675,800	112,587	2,549,900	788,387
1970	1,686,900	624,945	1,066,200	281,036	2,753,100	905,981
1971	2,173,800	842,036	1,723,200	514,964	3,897,000	1,357,000
1972	3,390,500	1,694,665	3,822,800	1,249,739	7,213,300	2,944,404
1973	4,178,600	1,912,128	3,638,700	1,264,597	7,817,300	3,176,725
1) 1974	45,948,900	2,716,196	2,930,300	751,270	48,879,200	3,467,466
1975	5,234,200	1,551,321	4,230,200	1,160,831	9,464,400	2,712,152
1976	2,384,700	2,111,317	6,321,900	1,683,187	8,706,600	3,794,504
1977	2,008,300	1,577,672	2,045,300	704,206	4,053,600	2,281,878

N/A - Not available

1) - Menhaden landings for this year were 42,186,800 pounds valued at $1,060,861.

* - Source: National Marine Fisheries Service, Department of Commerce

Table 10 Commercial Fish and Shellfish Landings in Delaware Bay and River, 1977*

Species	New Jersey Pounds	New Jersey Dollars	Delaware Pounds	Delaware Dollars	Total Pounds	Total Dollars
Alewives	1,000	66	-	-	1,000	66
Bluefish	33,200	3,252	31,100	3,081	64,300	6,333
Butterfish	-	-	100	24	100	24
Carp	34,700	3,431	28,000	2,520	62,700	5,951
Catfish	3,600	542	10,100	1,414	13,700	1,956
Croaker	3,300	514	8,900	1,841	12,200	2,355
Drum, red	-	-	200	13	200	13
Drum, black	11,000	1,649	-	-	11,000	1,649
Eels, common	17,800	6,671	95,900	49,281	113,700	55,952
Fluke	300	124	4,500	2,111	4,800	2,235
Herring, sea	1,100	41	-	-	1,100	41
Mackerel, Atlantic	-	-	500	77	500	77
Menhaden	41,900	2,016	24,600	984	66,500	3,000
Sea trout, gray	148,600	26,850	296,000	63,403	444,600	90,253
Shad	38,200	7,013	64,200	13,428	102,400	20,441
Sharks, grayfish	-	-	300	16	300	16
Spot	8,600	1,495	3,700	934	12,300	2,429
Striped bass	5,100	2,283	45,400	32,557	50,500	34,840
Sturgeon	200	31	-	-	200	31
White perch	17,000	3,539	21,000	6,907	38,000	10,446
Unclassified for food	400	71	1,300	185	1,700	256
Crabs, blue	296,800	112,716	878,200	322,560	1,175,000	435,276
Horseshoe crabs	-	-	400,000	4,000	400,000	4,000
Lobster, American	-	-	700	1,750	700	1,750
Oysters	1,218,200	1,400,372	127,500	196,190	1,345,700	1,596,562
Turtles, snapper	22,400	4,996	3,100	930	25,500	5,926
TOTAL	2,008,300	1,577,672	2,045,300	704,206	4,053,600	2,281,878

* Source: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service

Table 11 Ten most valuable commercial species landed in New Jersey from Delaware Bay, 1948 - 1977*

Species	Value	% of Total Landings	Pounds	% of Total Landings
Oyster	41,827,373	85.6	77,277,515	45.0
Blue crab	3,875,049	7.9	24,263,860	14.1
Menhaden	1,209,176	2.5	47,040,198	27.4
Hard clam	504,973	1.0	1,591,860	0.9
Striped bass	319,452	0.7	1,349,391	0.8
Eel	265,535	0.5	844,100	0.5
Shad	241,342	0.5	1,710,995	1.0
Weakfish	238,204	0.5	1,521,852	0.9
White perch	108,265	0.2	689,805	0.4
Carp	79,541	0.2	1,189,608	0.7
		99.6		91.7

* Source: Prepared from data supplied by the National Marine Fisheries Service, Department of Commerce

Table 12 U.S. Department of the Interior Designated Threatened/Endangered Species in the Lower Delaware River and Bay Region *

Species	Delaware	New Jersey	Pennsylvania
Blue whale, Balaenoptera musculus (E)	X	X	
Bowhead whale, Balaena mysticetus (E)	X	X	—
Finback whale, Balaenoptera physalus (E)	X	X	—
Humpback whale, Megaptera novaeangliae (E)	X	X	—
Right whale, Eubalaena spp. (E)	X	X	—
Sei whale, Balaenoptera borealis (E)	X	X	—
Sperm whale, Physeter catodon (E)	X	X	—
Bald eagle, Haliaeetus leucocephalus (E)	X	X	X
American peregrine falcon, Falco peregrinus anatum (E)	X	X	X
Arctic peregrine falcon, Falco peregrinus tundrius (E)	X	X	X
Brown pelican, Pelecanus occidentalis (E)	X	X	—
Green sea turtle, Chelonia mydas (T)	X	X	—
Hawksbill sea turtle, Eretmochelys imbricata (E)	X	X	—
Atlantic Ridley sea turtle, Lepidochelys kempi (E)	X	X	—
Leatherback sea turtle, Dermochelys coriacea (E)	X	X	—
Loggerhead sea turtle, Caretta caretta (T)	X	X	—
Shortnose sturgeon, Acipenser brevirostrum (E)	X	X	X

(E) - Endangered
(T) - Threatened

* Source: Federal Register - January 17, 1979

TABLE 13 - Recent Catches of the Shortnose Sturgeon in the Delaware River

Year	Location	Gear Description	Season	Number (Size)
1972	Del. R. RM 102-124	16 ft. semi-ballon otter trawl-fished on bottom	Oct-Nov	1 (400 mm)
1975	Mercer Power Plant RM 131	Four intake screens	August	1 (616 mm)
1977	Trenton, N.J. RM 131	700 ft x 8 ft experimental gill nets, 2.0, 3.0, 4.0, 5.0 stretch measure	June	2 (769 mm) (640 mm)

*Source: The Delaware River Basin Anadromous Fishery Project

AD-A094 799 ARMY ENGINEER DISTRICT PHILADELPHIA PA F/G 13/2
DELAWARE RIVER DREDGING DISPOSAL STUDY, STAGE 1 RECONNAISSANCE --ETC(U)
JUN 79
UNCLASSIFIED DAEN/NAP-10072/RR-79/06 NL

7 OF 12
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TABLE 14 - State of New Jersey, Department of Environmental Protection Designated Threatened/Endangered Species in the Lower Delaware River and Bay Region*

Shortnose sturgeon	Acipenser brevirostrum	(E)
Atlantic sturgeon	Acipenser oxyrhynchus	(T)
American shad	Alosa sapidissima	(T)
Southern gray treefrog	Hyla chrysoscelis	(E)
Eastern mud salamander	Pseudotriton montanus	(T)
Bog turtle	Clemmys muhlenbergi	(E)
Wood turtle	Clemmys insculpta	(T)
Indiana bat	Olyotis sodalis	(E)

Endangered (E) - A species whose prospects for survival in the state are in immediate danger due to one or many factors.

Threatened (T) - May become endangered if conditions surrounding the species begin to or continue to deteriorate.

*Source: New Jersey Department of Environmental Protection, Division of Fish Game and Shellfisheries.

TABLE 15 - Pennsylvania Fish Commission Designated Endangered/Threatened Fishes, Amphibians and Reptiles in the Lower Delaware River Region*

Shortnose sturgeon	_Acipenser brevirostrum_	(E)
Threespine stickleback	_Gasterosteous oculeatus_	(E)
Eastern tiger salamander	_Ambystoma tigrinum_	(E)
New Jersey chorus frog	_Pseudacris triseriata_	(E)
Coastal plain leopard frog	_Rana utricularia_	(E)
Eastern mud turtle	_Kinosternon subrubrum_	(E)
Red-bellied turtle	_Chrysemys rubriventris_	(E)
Bog turtle	_Clemmys muhlenbergi_	(E)

(E) = Endangered

(T) = Threatened

*Source: Pennsylvania Fish Commission

SUPPLEMENT *Acipenser brevirostrum* Lesueur, Shortnose sturgeon

ADULTS

D 33[17]–42;[1] A. 18–24;[9] C. 60; P. 30–31; V. 17–21;[18] dorsal shields 7[9]–13;[2] lateral shields 22[11]–34;[9] ventral shields 6[6]–11; gill rakers on first arch 22[2]–32.[9]

Proportions expressed as percent FL: Head length 18–22.[10] Proportions expressed as percent HL: Postorbital distance 51[2]–62; interorbital width 31–40;[10] snout length 37–50. Proportions expressed as percent snout length: Mouth width 44–77.[9] Proportions expressed as percent postorbital distance. Snout length 64–89.[10] Proportions expressed as percent interorbital width: Mouth width 63–90.[1] Proportions expressed as times in TL: Greatest depth 6.75, head 4.80. Proportions expressed as times in HL: Eye ca. 14.[6]

Body elongate,[6] pentagonal in cross-section,[7] with 5 rows of enlarged shields.[2] Head large, convex, depressed between eyes,[18] snout, as compared to *A. oxyrhynchus* of similar size, shorter, more blunt, proportionately wider at base.[17] 4 barbels in ventral transverse row 1/3 to 1/2 distance from snout tip to upper lip.[9] Mouth width inside lips more than 3/5 width of bony orbit.[9] Eye small,[6] pupil rounded,[17] gill rakers rather long, triangular.[2] Shields regular, oblong, with sharp keel,[15] space separating dorsal shields as much as 1/2 length of shields themselves.[7] Postdorsal and preanal shields single or paired. No enlarged bony plates between base of anal fin and lateral row of shields.[9] Upper lobe of caudal much longer than lower, dorsal fin just before caudal peduncle; anal fin under posterior portion of dorsal fin; pectoral fins just behind gill openings, ventral fins at beginning posterior 1/3 of body.[6]

Pigmentation: Brown above, tinged with copper on the sides (WLD), below lateral shields reddish mixed with violet, abdomen white.[15] Dorsal shields with whitish centers, lateral shields paler than surrounding skin; viscera blackish.[6] Iris with greenish tint (WLD).

Maximum size: 1353 mm TL;[1] 16.5 kg.[10]

DISTRIBUTION AND ECOLOGY

Range: St. John River, New Brunswick,[3] to St. Johns River, Florida;[2] rare and endangered.[1,19]

Area distribution: Possibly before Delaware[2] and Potomac Rivers,[5] also recorded from Virginia.[4]

Habitat and movements: Adults and juveniles—found most often in tidal rivers,[7] also recorded from open sea some distance from parent stream.[6] In St. John River, New Brunswick migrations to overwintering areas take place in September and October.[10] Overwintering occurs in estuarine lakes at depths exceeding 10 m,[9,10] and deeper regions of the lower estuary in salinities up to 20 ppt and temperatures of 4–8 C. During April move out of overwintering areas and concentrate in river channels. Around mid-June movement to summer feeding areas occurs.[10]

Larvae—on bottom for several days after hatching.[14]

SPAWNING

Location: Middle reaches of large tidal rivers.[1] In the St. John River, New Brunswick, spawning apparently occurs in the upper estuary adjacent to deep, turbulent sections of the river in extremely turbid water.[10]

Season: Females with mature eggs taken from the Hudson River in December (WLD), February[11] and April.[2] Spawning in the St. John River, New Brunswick, takes place between May 15 and June 15[10] and may continue until late August or early September.[8]

Time: During peak flood tide.[10]

Temperature: Average 10 C.[10]

Salinity: Fresh during spawning; possibly becoming brackish with changes in tidal cycles.[10]

Fecundity: 48,000–99,000.[19]

EGGS

Mature ovarian eggs—average diameter 3.0 mm;[10] dark brown in color.[2]

Fertilized eggs—demersal, extremely adhesive just after fertilization, after ca. 2 hours essentially nonadhesive.[2]

Pigmentation: Brown 1/2 circumference, grayish white other 1/2, eye visible 6 days after fertilization, light in color; 8–9 days after fertilization darker, plainly visible.[2]

Incubation: 4–6 days at unspecified temperature;[12] at 7.8–12.2 C, 13 days.[2]

YOLK-SAC LARVAE

Very dark in color,[14] otherwise no information.

LARVAE

No information.

JUVENILES

Specimen described 197 mm FL.[3]

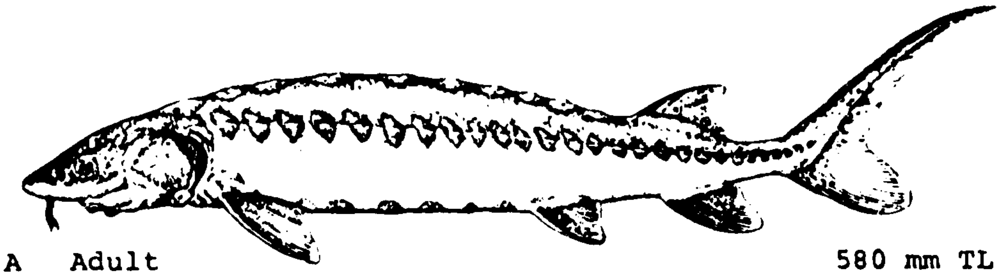

Fig. 3. *Acipenser brevirostrum*. Spawning female 580 mm TL. (*Vladykov, V. D., and J. R. Greeley, 1963: fig. 8.*)

Head 28% of FL, postorbital distance 33% of HL.[2]

Snout longer than postorbital distance. Scutes on 5 main rows sharp, set closely together.[2]

AGE AND SIZE AT MATURITY

In St. John River, New Brunswick, 8.8±1.7 years, but females apparently do not spawn until 15.5±1.4 years, even though mature.[19] (Reports of 4–8 years in both sexes in the Hudson River [7] are based on incorrect aging methods. WLD.) Males may mature at 490 mm,[7] most above 533 mm are mature.[7] Smallest mature female 460 mm, smallest ripe female 700 mm TL.[19]

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UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
112 West Foster Avenue
State College, PA 16801

April 23, 1979

Colonel James G. Ton
Philadelphia Corps of Engineers
Custom House, 2nd & Chestnut Streets
Philadelphia, Pennsylvania 19106

Dear Colonel Ton:

In accordance with our FY79 Scope of Work agreement for the Delaware River Dredging Disposal Study, attached is our preliminary report "Fish and Wildlife Inventory of the Lower Delaware River and Bay Region."

Sincerely yours,

Michael T. Chezik

for Charles J. Kulp
Field Supervisor

Fish and Wildlife Inventory
of the Lower Delaware River
and Bay Region

Prepared For:

The Philadelphia District
Army Corps of Engineers
Delaware River Dredging
Disposal Study

Prepared By:

U.S. Fish and Wildlife Service

April 1979

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I. Introduction

This is a preliminary report on fish and wildlife resources of the lower Delaware River and Bay Region, provided in response to the Philadelphia District, Army Corps of Engineers, Delaware River Dredging Disposal Study. The purpose of the Congressionally authorized study is to develop a regional dredging spoil disposal plan for the tidal portions of the Delaware Bay, extending from Trenton, New Jersey, to the sea. The study was authorized by the United States Senate Committee on Public Works on September 20, 1974.

This report contains brief descriptions of finfish, benthic invertebrates, commercial and recreational fisheries, wetland wildlife and uses, and threatened/endangered species. It also contains a short discussion identifying areas sensitive to the disposal problem. The report addresses the river, bay, tidal segments of tributaries to each, and adjoining wetlands. Inland habitats are excluded from the discussion.

This report is submitted in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). It has been coordinated with the New Jersey Division of Fish, Game and Shellfisheries; the Delaware Division of Fish and Wildlife; the Pennsylvania Game and Fish Commissions; and the National Marine Fisheries Service.

II. Finfish

Delaware River

Homa (1978) reviewed benthic invertebrate and finfish literature for the Delaware River between Trenton (RM133) and the Chesapeake and Delaware Canal (RM53). His review emphasized shallow water areas while omitting deepwater and tributary habitats. Studies concerning the omitted habitats are briefly discussed below.

Miller et al (1974) conducted deepwater trawling at five stations in the Delaware River between Trenton and the Chesapeake and Delaware Canal during August to December 1973. The station names and locations are as follows: Trenton, RM 127-131; Bristol, RM-114-118; Bridesburg, RM 114-118; Philadelphia, RM 127-131; and Chester, RM 81-86. Eight-hundred and forty-three collections produced 15,043 fish of 21 species. Blueback herring made up 42 percent of the catch. Other species were white perch, 31 percent; spotted shiner, 8 percent; channel catfish, 8 percent; and white catfish, 5 percent (Table 1). In addition to these stations, the Schuylkill River, Neshaminy Creek and the main river adjacent to Wilmington were periodically trawled during this period. One hundred and forty-three collections produced 3,082 fish of 16 species. Blueback herring, spot, white perch and satinfin shiner made up 43, 38, 5 and 5 percent of the catch, respectively (Table 2).

In a separate study, Miller et al (1974) sampled 14 Delaware River tidal tributaries between Trenton and Wilmington from April to November 1973. A total of 14,410 fish of 31 species were collected by seine and trawl. Anadromous species were taken in all 14 tributaries. Blueback herring accounted for 91 percent of the anadromous catch followed by white perch (5 percent), alewife (4 percent) and American shad and striped bass (<1 percent). Blueback herring and alewife were generally more abundant in the tributaries which held the greatest variety and/or number of fish (Table 3).

Additional fish sampling was undertaken in the lower reaches of the Christina River and Brandywine Creek in spring and summer, 1978. Electrofishing by boat in the Christina River produced 12 species. The most abundant fish were carp, silvery minnow, menhaden, alewife and blueback herring. Similar sampling of the lower reach of Brandywine Creek resulted in 28 species collected. The most abundant fish in the Brandywine sampling were silvery minnow, carp, blueback herring, spottail shiner, white sucker, American Eel, alewife and white perch (Reichard, 1978).

Fish surveys by the Pennsylvania Fish Commission confirm that Darby Creek, Pennypack Creek and Neshaminy Creek support runs of blueback herring and alewife. American shad are not known to spawn in any of the Pennsylvania tributaries (Marshall, 1978)

The New Jersey Division of Fish, Game and Shellfisheries has surveyed several of the New Jersey tributaries in this reach. The results of their surveys were recently compiled and included in the Service's "Planning Aid Report: Existing Fish and Wildlife Resources Related to the Southern New Jersey Water Resources Study, Burlington, Camden and Gloucester Counties, New Jersey" (U.S. Department of the Interior, 1978).

Delaware Bay

Study of finfish in Delaware Bay began in the early 1950's. Since then, numerous studies have emphasized the variety of finfish present within the estuary. These include reports by Daiber (1954 a and b); Fitz (1956); June and Reintjes (1957); Harmic (1958); Bearden (1959); Reintjes and Roithmayr (1960); de Sylva and Kalber (1960); de Sylva, Kalber and Shuster (1962); Murawski (1966); Daiber and Abbe (1967); Daiber and Wockley (1968); Kaney, Schuler and Denoncourt (1969); Smith (1969); Daiber and Smith (1969, 1970 and 1971 a and b); and Bason (1971). Many of these studies and others are briefly described in Polis (1972), Maurer and Wang (1973) and Maurer (1974).

Two hundred and eighteen species of finfish have been collected from the Delaware Bay region (Maurer and Wang, 1973) (Table 4). Nearly half of these are restricted to the higher salinity waters. About 40 species occur in marine and brackish water. Another 40 species occupy marine, brackish and freshwater. The remainder inhabit brackish and freshwater or freshwater.

Studies by de Sylva, Kalber and Shuster (1962) and Abbe (1967) indicate that the estuary is primarily important as a breeding ground for fish (over 60 species) and a nursery for juveniles.

Upper Estuary

Thomas (1971) collected 90 species of finfish from the Artificial Island area, including the river and four tidal creeks (Appoquinimink, Blackbird, Alloway and Hope Creeks) (Table 5).

Schuler (1971) collected 42,000 fish comprising 42 species in daylight seine samples. The 10 most abundant species, comprising 98 percent of the total, were Atlantic silverside, bay anchovy, blueback herring, mummichog, Atlantic menhaden, striped bass, white perch, alewife, rough silverside and tidewater silverside. Over 45,000 specimens were collected in daylight bottom hauls. Of these, 99 percent consisted of bay anchovy, weakfish, white perch, hogchoker, alewife, blueback herring, American eel, striped bass, bluefish and brown bullhead. According to Schuler, the Artificial Island area is an important nursery for weakfish, white perch striped bass and black drum, all sportfish species.

Lower Estuary

Daiber and Smith (1971 b) conducted the most recent comprehensive survey of finfish in the bay below Cohansey River during 1966 through 1970. A total of 136,093 fish of 69 species was caught. Weakfish (31 percent), hogchokers (23 percent), scup (13 percent), northern sea robin (4 percent) and windowpane (4 percent), comprised three-fourths of the catch (Table 6). Species diversity was less in the upper bay than in the lower bay and was greatest everywhere during the summer and fall.

Daiber (1954 b) gives the relative abundance of fish taken in commercial trawl samples during 1951 through 1954. The 10 most abundant fish were weakfish, spot, scup, hogchoker, summer flounder, northern sea robin, Atlantic croaker, spotted hake, butterfish and white perch. Five of Daiber's top 10, the summer flounder, Atlantic croaker, spotted hake, butterfish and white perch, all important recreational and commercial

species, do not occur in the top 10 of the 1971 study. The studies suggest that the smooth dogfish, roughtail ray, bullnose ray and striped sea robin are slowly becoming more abundant, while the clearnose skate, silver hake, summer flounder and northern puffer are, in general, declining in abundance.

Tidal Tributaries

Although the New Jersey Division of Fish, Game and Shellfisheries has surveyed many of the streams draining into Delaware Bay, most were surveyed in the upper non-tidal reaches. Fishery data for the tidal segments are scarce. The Maurice River is an exception. Himchak (1978) and McClain (1978) sampled ichthyoplankton and finfish in the lower Maurice from October 1975 to September 1976. Planktonic forms of 23 fish species were collected. Bay anchovy, naked goby, Atlantic croaker, spot, menhaden and American eel made up 98 percent of the collection. Additional species were taken as either adults or juveniles.

Many streams in New Jersey support spawning runs of alewife or blueback herring (Table 7). None are known to support spawning runs of American shad.

Martin (1974) sampled 13 Delaware tidal streams draining into Delaware Bay. These included Reybold Creek, Silver Run, Appoquinimink River, Blackbird Creek, Smyrna River, Leipsic River, Simons Creek, Mahon River, Little River, St. Jones River, Murderkill River, Mispillion River and Broad Creek. Indian River, Rehoboth and Little Assawoman Bays were also sampled. The results show tidal streams are important nursery, forage and spawning habitats for a variety of fishes. Species commonly present in adult and/or juvenile stages are white perch, weakfish, spot, menhaden, American eel, blueback herring, alewife, striped bass, bay anchovy, naked goby, white mullet, winter flounder and silverside shiner. The less saline segments usually contain white catfish, channel catfish, carp and yellow perch.

III. Benthos

The first published account of benthic assemblages in Delaware Bay was a paper on the associated oyster fauna (Maurer and Watling, 1973). A series of papers dealing with the distribution and ecology of specific taxa was also completed: Amphipoda (Watling and Maurer, 1972a); Hydroids (Watling and Maurer, 1972b); Pelecypoda (Maurer, Watling and Aprill, 1974); Isopoda (Watling, Lindsay and Maurer, 1974); and Gastropoda (Leathem and Maurer, 1975). Additionally, Kenner, Maurer and Leathem (1975) described animal-sediment associations of dominant benthic species.

Watling, Maurer and Wethe (1976) undertook the first comprehensive sampling of benthic invertebrates in Delaware Bay. During July and August 1972 and June and July 1973, 207 samples were taken along 26 transects between Cape Henlopen and Stone Creek. One hundred and nine species were obtained during 1972 and 125 during 1973 (Table 8). There were no significant changes in relative abundance of phyla from one year to the next. The average numer of individuals per sample for both 1972 and 1973 was 20 (200 individuals/m^2). At only ten stations of the 207 sampled were there more than 1,000 individuals/m^2. The authors suggested the low densities were due to a lack of attached benthic macroscopic algae or vascular plants in the bay, which in turn, was most likely related to the highly turbid conditions in the bay. The absence of macroscopic benthic algae deprives the benthic community of a major source of organic material that would be used by deposit feeders. The most widespread species were Tellina agilis, Heteromastus filiformis, Glycera dibranchiata, Nephtys picta, Mulinia lateralis, Protohaustorius wigleyi, Gemma gemma and Nucula proxima.

Benthic invertebrate studies for the Delaware River are described by Homa (1978). We were unable to locate any relevant information not covered in Homa's report.

IV. Commercial Fisheries

The National Marine Fisheries Service, Department of Commerce records commercial finfish and shellfish catches within the Delaware River and Bay. The mean values for catches recorded from 1960 through 1977 and from 1973 through 1977 are approximately $1.7 and $3.1 million respectively (Table 9).

Species composition, poundage and value of 1977 commercial finfish and shellfish catches for Delaware Bay and River, are given in Table 10. Oysters comprised 70.0 percent of the total harvest value. Blue crabs were a distant second at 19.1 percent followed by sea trout 4.0 percent, eel 2.5 percent, and striped bass 1.5 percent. Together these five species made up 97.1 percent of the total 1977 harvest value.

Analysis of catches landed from the New Jersey side of Delaware Bay, 1948 through 1975, reveals that oysters comprised 85.6 percent of the harvest value (Table 11). Other species comprising the top 5 were blue crab (7.9 percent), menhaden (2.5 percent), hard clam (1.0 percent) and striped bass (0.7 percent). Together these 5 species comprised 97.7 percent of the 1948-1975 harvest value (New Jersey side only).

The paramount importance of the oyster to commercial fisheries in Delaware Bay, both in the past and present, is evident from the catch data. A description of the oyster industry is found in the Service's planning aid report: "The Effect of Salinity Change on the American Oyster in Delaware Bay (1979)."

Second in importance is the blue crab. It occurs from the vicinity of Philadelphia to the mouth of the bay, and is commonly found in tidal tributaries. Harvesting is by potting and dredging. Potting occurs during non-winter months, while dredging is a winter time activity restricted to deepwater sediments. Approximately 3,000 acres of bay bottom in New Jersey are leased for dredging crabs. In Delaware leasing is not a requirement, but fisherman may not dredge in leased oyster grounds. Most dr ging occurs in the lower bay.

In the past and occassionally in recent years (e.g., 1974) the Atlantic menhaden has been an important species. According to Homa (1978) menhaden probably spawn in the deeper areas of Delaware Bay. They use the shore zones and tidal creeks of the lower estuary as nursery areas. Menhaden are processed for fish meal and oil.

Besides being an important sportfish, the weakfish is also a valuable commercial species. Weakfish enter the bay in early May. Spawning occurs from late May to early August along the shoals and in the Delaware River. Juveniles are found in upper tidal tributaries such as Silver Run, Appoquinimink, Blackbird, Smyrna and Mahon Creeks in Delaware (Martin 1974) and Alloway, Hope (Smith 1971); Dividing and Oranoaken Creeks (McClain 1978), New Jersey. In late September, the large weakfish begin leaving the bay, followed by the smaller fish and eventually the young of year (Martin 1974).

The striped bass is another fish with both commercial and recreational importance. Formerly a common migrant in the Delaware River, it now spawns primarily in the vicinity of Artificial Island and in the Chesapeake and Delaware Canal. The juveniles inhabit tidal streams until their third year when they travel to the ocean (Martin 1974).

The American eel is a catadromous species. It spawns in the Atlantic Ocean, but migrates to brackish or freshwater to spend most of its juvenile and adult life. The eel prefers muddy bottom streams and is present throughout the lower Delaware drainage.

The hard clam is widely distributed throughout lower Delaware Bay, but is not present in commercial densities. A 1972 survey of the west side of the bay disclosed two areas with potential as commercial clam beds: Joe Flogger and Old Bare Shoals (Keck, Watling and Maurer, 1972).

V. Recreational Fisheries

In 1961, the Fish and Wildlife Service estimated that approximately 130,000 saltwater sportfishermen annually devote 900,000 man-days to fishing within Delaware Bay. Most of these were finfishermen. However, an uncounted number also engaged in clamming and crabbing. The six finfish species that accounted for the largest annual harvests by sportfishermen were bluefish, scup, weakfish, summer flounder, sea bass and croaker (U.S. Fish and Wildlife Service, 1962).

Martin (1973) reported 330,935 man-days of sportfishing from boats in western Delaware Bay in 1973, with an average number of 2.8 anglers per private boat, 8.0 per charter boat and 38.5 per head boat. Weakfish comprised 90 percent of the 1971-73 sport catch.

Using Martin's data, Smith (1975) estimated that boat fishing contributes $4.5 million to the west bay economy. He also determined from use surveys that boat fishing was concentrated in the lower bay, especially in areas associated with the navigation channel running through the Ship Anchorage or lightering area; that weakfish, summer flounder, black sea bass, and black drum were the primary species sought by Delaware head boats; and that the mean number of sportfishing boats in western Delaware Bay on weekdays and Sundays was 180.4 ± 6.9 and 447.6 ± 162.3, respectively.

The most recent (1976) survey of sportfishing in Delaware by Miller (1977) showed no appreciable change in sportfishing effort by boaters since 1973. However, shore fishing effort had appreciably increased from 128,512 man-days in 1973 to 225,129 man-days in 1976. The author cautioned that any real differences in fishing pressure could have been masked by differences in survey compilation techniques. Future studies on sportfishing in Delaware, occuring at approximately three year intervals, should avoid this problem.

For eastern Delaware Bay (Salem, Cumberland and Cape May Counties) an estimated 300,000 to 650,000 man-days of sportfishing effort are expended annually from April through November. Boat fisherman account for 75 to 80 percent of the effort and about 95 percent of the catch. At least 85 percent of the fish landed by boat fisherman are weakfish. Boat fisherman also catch summer flounder, bluefish, spot, striped bass, black sea bass, white perch, kingfish, winter flounder, black drum, shark, carp, catfishes, and American eel. White perch make up from a third to a half of the catch of shore fisherman, with summer flounder, bluefish, striped bass, spot, winter flounder, catfishes, carp and American eel making up the remainder (U.S. Fish and Wildlife Service, 1975).

The Pennsylvania Fish Commission (1975) estimates that the Delaware River in Philadelphia and Delaware Counties provides approximately 56,000 man-days of fishing annually for alewife, blueback herring, shad, bullhead, sucker, sunfishes, carp and eel. The Schuylkill River in Philadelphia County provides approximately 43,000 man-days for identical species, including muskellunge.

Fisherman use estimates for the New Jersey side of the river are not available. However, we would expect an amount similar to that occurring from Pennsylvania.

Fisherman use data for the tidal tributaries is generally lacking. Martin (1978) provides guidance to fishermen on where and how to catch fish in the Delaware tributaries, but does not indicate a current level of use. Figley (1978) conducted a year-long use survey of the Maurice River estuary between October 1975 and September 1976. Part of the survey included a section of Delaware Bay (Maurice River Cove). As might be expected, recreational use peaked during summer (August) and reached a low point in winter (January). Bank and boat fishing amounted to 15,986 and 15,179 man-days respectively.

Based on the survey information available, fisherman use of the lower Delaware River, Delaware Bay and tidal tributaries is at least 1.2 million man-days per year. We estimate that 90 percent of the use is by saltwater anglers and 10 percent is by warmwater fishermen. Since saltwater fishermen spend an average $16.65 per man-day of angling (U.S. Department of the Interior, 1977), saltwater fishermen annually contribute an estimated $18.0 million to the regional economy. The average man-day expenditure by warmwater fishermen is $8.48. Therefore, the annual contribution from warmwater fishermen is $1.0 million. We regard these as conservative estimates. Additional fisherman use surveys, particularily on the tidal tributaries, might increase these estimates.

VI. Wetland Wildlife and Uses

A 1973 survey by the Academy of Natural Sciences disclosed that the Delaware River, estuary and tributaries between Trenton, New Jersey and Cape May - Henlopen drain approximately 176,000 acres of freshwater and brackish water wetlands (1). Approximately 10,000 acres are of the freshwater type and occur between Trenton, New Jersey and Wilmington, Delaware. The remaining 166,000 acres are mainly brackish and occur between Wilmington and Cape May - Henlopen. The more common freshwater wetland plants are Scirpus americanus, S. olneyi, Polygonum punctatum, various species of Eleocharis and Sagittaria, Zizania aquatica, Peltandra virginica, Nuphar advena and species of Pontederia and Lythrum. Where channelization, ditching or filling has occurred, Phragmites communis is often dominant. Brackish water vegetation is characterized by Spartina alterniflora, S. patens and Distichlis spicata (The Academy of Natural Sciences, 1973).

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(1) A 1961 survey by the Service disclosed approximately 206,000 acres of wetlands within the Coastal Plain physiographic section. The 1961 survey encompassed a slightly larger area than did the Academy of Natural Sciences survey, and this largely accounts for the disparity between the two survey estimates.

The freshwater and brackish water wetlands and adjoining upland provide essential habitat for a variety of vertebrates collectively identified as wetland wildlife. As least 144 species of birds, including 30 species of waterfowl, 39 species of shore and wading birds, 16 birds of prey and 59 others, occur in or near wetlands. Added to these are 22 amphibians, 22 reptiles and 17 mammals, all occurring in or near wetlands.

An estimated 300,000 ducks and geese overwinter in these wetlands. About 225,000 (76 percent) inhabit the Delaware marshes. Of these, 150,000 are Canada geese (Graham, R. 1979). Approximately 55,000 waterfowl (18 percent) overwinter in New Jersey (U.S. Fish and Wildlife Service, 1975). Wetlands in Pennsylvania, principally Tinicum Marsh, overwinter the remaining 20,000 (7 percent). Over 75 percent of the Pennsylvania waterfowl are diving ducks (W. Drasher 1979). Although most of the 300,000 waterfowl leave the basin wetlands after winter, a substantial number, mainly puddle ducks, remain to breed.

A 1977-78 survey of waterfowl hunting in the Delaware portion of the basin disclosed that 22,200 hunters expended 183,600 man-days hunting ducks, geese and rails (Florio 1979). A similar survey of the New Jersey portion in 1974-75 disclosed 17,800 hunters and 115,400 man-days (New Jersey Division of Fish, Game and Shellfisheries, undated). Such surveys have not been conducted in Pennsylvania. However, the Pennsylvania Game Commission indicates that hunting pressure there is substantially less than in New Jersey (Drasher 1979). Based on the two surveys and a conservative guess in Pennsylvania, we estimate that the basin below Trenton annually provides 43,000 hunters 320,000 man-days of waterfowl hunting. Since migratory bird hunters spend an average $10.82 per man-day of hunting (U.S. Department of Interior, 1977), waterfowl hunters annually contribute an estimated $3.5 million to the regional economy.

The basin wetlands also support a valuable fur industry. Muskrat and raccoon are most important. Other less important species are red and gray fox, opposum, mink, weasel and skunk.

A 1977 survey of trapping in New Jersey revealed that 1,369 trapping licenses were sold in counties comprising the New Jersey side of the basin (1). Trappers expended approximately 77,000 man-days trapping within these counties. The harvest was valued at $1.4 million (New Jersey Division of Fish, Game and Shellfisheries, 1977). In Delaware, a 1977-78 survey revealed that 2,000 trapper/hunters expended 41,000 man-days trapping muskrat and trapping/hunting raccoon. The total furbearer harvest from the Delaware side of the basin was valued at [illegible] million. Surveys of furbearer harvests in Pennsylvania have not been undertaken. Because Pennsylvania has the least amount of wetland and is

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(1) Burlington, Camden, Cape May, Cumberland, Gloucester and Salem.

the most developed of the three states, it is reasonable to expect that it produces the lowest furbearer harvest. Considering the two surveys and a conservative guess of the Pennsylvania harvest, we estimate the annual value of the furbearer resource below Trenton at $2.1 million.

According to the "1975 National Survey of Hunting, Fishing and Wildlife - Associated Recreation," 27 percent of the U.S. population 9 years or older in 1975 participated in wildlife observation and 8 percent engaged in wildlife photography. Wildlife observation amounted to 1.6 billion man-days or 33 man-days per wildlife observer. Wildlife photography totaled 156.7 million man-days or 10 man-days per wildlife photographer (U.S. Department of Interior, 1977).

The Delaware River Basin Commission estimates that 1.8 million people reside in the Coastal Plain section of the basin (Kausch 1979). According to the national average, 86 percent or approximately 1.5 million of these people are 9 years of age or older. Using the referenced population percentages for wildlife observer (27 percent) and wildlife photographer (8 percent), we estimate the numbers of wildlife observers and wildlife photographers in the Coastal Plain are 405,000 and 120,000 respectively. The estimated numbers of man-days expended on wildlife observation and wildlife photography are 13.4 million and 1.2 million, respectively. The 1975 national survey did not indicate average expenditures for wildlife observers or wildlife photographers. However, if each wildlife observer and photographer spent only $10 annually, the contribution to the economy would be $5.3 million. The actual value is probably higher.

VII. Threatened/Endangered Species

The lower Delaware River and Bay Region is within the historic range of 17 federally designed threatened or endangered species (Table 12): seven whales, five marine turtles, four birds and one fish. The whales and turtles are primarily oceanic, but occassionally venture into Delaware Bay. Three of the birds are raptorial and migrate through the area. The other bird, the brown pelican, is a rare visitor. The shortnose sturgeon inhabits the river and possibly the upper bay.

Information on the specific distribution of these species and their life requirements is often fragmentary. This is particularily true of the shortnose sturgeon, a bottom dwelling fish potentially most likely to be affected by dredging/filling. The little information known about the shortnose is mainly the result of research conducted from the St. John River, New Brunswick. This work and other relevant studies were recently summarized in the Fish and Wildlife Service publication "Development of Fishes of the Mid-Atlantic Bight" (1978). A copy of the summary is included at the end of this report. Also included is a summary of recent shortnose collections from the Delaware River made by biologists from the Delaware River Basin Anadromous Fishery Project, Rosemont, New Jersey (Table 13).

No federally designated or proposed threatened or endangered plants occur within the project area. However, four indigenous plants are being considered for addition to the threatened species list (Federal Register, Volume 40, No. 127, July 1, 1975). These are Nuttall's micranthemum, purple fringeless orchis, Long's bulrush and Pine Barren's reedgrass. It should be emphasized that none of these species have been officially proposed for addition to the threatened list. Therefore, they are not currently subject to the protection afforded by the Endangered Species Act, as amended in 1978. We mention them simply because they could be officially proposed during project planning, which would then make them subject to the Act.

Nuttall's micranthemum, Micranthemum micranthemoides, a member of the figwort family, is normally found on tidal mudflats. Collectors have taken specimens adjacent to the Delaware River in Bucks and Philadelphia Counties, Pennsylvania and Camden and Burlington Counties, New Jersey. It has also been recorded from similar habitat in Delaware.

Purple fringeless orchis, Habenaria peramoena, a member of the orchid family, occurs in meadows, bogs, alluvial thickets and low woods. It may also be found along saltmarsh margins. Collectors have taken specimens in Camden and Cape May Counties, New Jersey and Chester County, Pennsylvania. It has also been taken in Delaware.

Long's bulrush, Scirpus longii, occurs in freshwater marshes and swamps in Burlington County, New Jersey.

Pine Barren's reedgrass, Calamovilfa brevipilis var. brevipilis, occurs in swamps and bogs of Burlington and Cape May Counties, New Jersey.

Species designated as threatened or endangered by the individual basin states are shown in Tables 14 and 15. The Delaware list (not shown) is the same as the Federal list. Pennsylvania currently does not have a list of threatened or endangered birds and mammals.

This section does not fulfill requirements in accordance with Section 7 of the Endangered Species Act, as amended in 1978. For specific guidance on formal consultation procedures, we recommend the Corps review the Federal Register, Volume 43, No. 2, dated January 4, 1978.

VIII. Areas Sensitive To The Disposal Problem

Our current knowledge of fish and wildlife resources in the lower Delaware River Basin is largely the result of a long succession of proposals to modify the environment. This is not an unusual situation and commonly occurs elsewhere in the United States. Unfortunately, the value of sporadic biological study is quite limited. This is particularily true

for the study of estuarine biota, which depend upon or are subject to a myriad of natural or artificial regulations, including temperature, flow, salinity, water quality, substrate, food, season, cover, etc. Any one of these factors and certainly many more individually or synergistically determine species presence, abundance, activity and human use. Despite such variables, certain generalizations are valid and have long been noted in our correspondence to the Army Corps of Engineers.

Wetland plants, including emergent, submergent and floating leaf hydrophytes, nearly always provide valuable habitat for fish and wildlife. They provide food and cover for many species and also serve as sites for reproduction and early growth. The study area still has a significant wetland acreage. Unfortunately over 90 percent of the wetlands occur south of Wilmington. Therefore, remaining wetlands north of this city take on added importance. The Service is committed to protection of all wetlands and generally seeks opportunities to create additional wetland areas. We particularily would like to see new wetlands created between Trenton and Philadelphia.

Non-vegetated shallow water areas also provide food, cover and nursery and spawning habitat. Although it is not well-documented, the current biological opinion is that non-vegetated shallows can be made more productive by establishing wetland plants. This generalization is not necessarily true for all shallows, or for that matter, all species. For example, smallmouth bass seek out gravel bottom shallows for spawning.

The Service is generally protective of shallow water areas, particularily where water quality is good or is likely to improve. We occassionally approve conversion of deepwater areas into shallow water habitats, but prefer that the shallows, once created, also be planted with wetland vegetation. These proposals must be reviewed on a case by case basis.

Vegetated wetlands and shallow water areas, are not the only sites sensitive to the disposal problem. Other sensitive areas include oyster seed beds and leased areas, blue crab dredging areas, hard clam beds, spawning and nursery grounds for important commercial/recreational finfish and islands. Islands serve as natural refuges for migrating waterfowl and other bird life and are sometimes heavily used for nesting (e.g., Pea Patch Island).

In general, the body of biological information available suggests that developed areas are least valuable for fish and wildlife. A good example of this is the Philadelphia - Wilmington corridor which has a limited fish population for about half the year. The problem is due mainly to poor water quality. Even if water quality significantly improved, it is likely that fish productivity there would still be lower than in other less developed areas where habitat is more diverse. Improved water quality would, however, significantly benefit migratory species (e.g., American shad).

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X. Tables and Supplement

Table 1 SUMMARY OF TOTAL CATCH BY NUMBER, RANK, AND PERCENT FOR FIVE TIDAL RIVER TRAWLING STATIONS, DELAWARE RIVER - 1973

	Rank	Trenton	Bristol	Bridesburg	Philadelphia	Chester	Total	% Total Catch
No. Species		13	16	13	10	14	21	
No. Specimens		3899	7920	2217	365	642	15043	
No. Collections		156	159	180	177	171	843	
Blueback Herring	1	678	3670	1425	158	427	6358	42.3
White Perch	2	1533	2578	367	43	71	4592	30.5
Spottail Shiner	3	1032	132	27	4	1	1196	8.0
Channel Catfish	4	53	862	40	0	0	955	6.3
White Catfish	5	420	275	82	1	2	780	5.2
Alewife	6	66	241	85	57	2	451	3.0
Silvery Minnow	7	19	34	6	85	110	254	1.9
American Eel	8	8	14	176	8	5	211	1.4
Brown Bullhead	9	73	13	1	1	12	100	0.7
Bluegill	10	0	74	0	0	4	78	0.5
Tessellated Darter	11	11	10	1	0	0	22	0.1
American Shad	12	4	9	0	2	0	15	*
Striped Bass	13	0	1	3	0	4	8	*
Mummichog	14	0	0	0	6	1	7	*
White Sucker	15	0	5	0	0	0	5	*
Gizzard Shad	16	1	0	2	0	1	4	*
Banded Killifish	17	0	0	2	0	1	3	*
Largemouth Bass	18	0	1	0	0	0	1	*
Fallfish	18	1	0	0	0	0	1	*
Carp	18	0	0	0	0	1	1	*
Golden Shiner	18	0	1	0	0	0	1	*

* - Less than one-tenth percent

Table 2 SUMMARY OF TOTAL CATCH BY NUMBER, RANK, AND PERCENT
AT THREE ADDITIONAL TRAWLING STATIONS, TIDAL DELAWARE RIVER - 1973

Species	Rank	Wilmington	Neshaminy Creek	Schuylkill River	Total	% Total Catch
No. Species		12	5	4	16	
No. Specimens		2846	83	153	3082	
No. Collections		30	5	26	106	
Blueback Herring	1	1316	72	0	1388	43.4
Spot	2	1169	0	0	1169	37.9
White Perch	3	155	2	0	157	5.1
Satinfin Shiner	4	0	0	150	150	4.9
Spottail Shiner	5	85	1	0	86	2.8
American Eel	6	65	0	0	65	2.1
Alewife	7	39	0	0	39	1.3
Bluegill	8	0	7	1	8	0.3
Striped Bass	9	7	0	0	7	0.2
Brown Bullhead	10	5	0	1	6	0.2
Yellow Perch	11	2	0	0	2	*
American Shad	12	0	1	0	1	*
Black Crappie	12	1	0	0	1	*
Carp	12	1	0	0	1	*
Mummichog	12	0	0	1	1	*
Pumpkinseed	12	1	0	0	1	*

*/ Less than one-tenth percent

Table 3 CATCH OF INDIVIDUAL ANADROMOUS SPECIES, NUMBER OF OTHER FISH, AND SPECIES DIVERSITY FROM 14 TIDAL DELAWARE RIVER TRIBUTARIES - 1973

Tributary Name	River Mile	American Shad	Blueback Herring	Alewife	Striped Bass	White Perch	Other Species	Variety Species	Total All Fish
1. Christina River	71	0	297	26	0	15	264	15	602
2. Brandywine Creek	71	0	1	0	0	0	2	3	3
3. Oldmans Creek	77	0	1200	4	0	2	244	11	1450
4. Raccoon Creek	81	0	778	4	0	2	591	15	1375
5. Darby Creek	85	0	3	0	0	0	1317	3	1320
6. Mantua Creek	90	0	70	1	0	2	379	9	452
7. Woodbury Creek	92	0	1968	191	0	65	1385	13	3609
8. Big Timber Creek	95	0	567	0	0	2	550	11	1119
9. Cooper River	102	0	44	0	1	167	458	11	670
10. Pennsauken Creek	105	0	444	23	0	0	187	8	654
11. Pennypack Creek	110	4	1	0	0	0	79	8	84
12. Rancocas Creek	111	1	835	0	0	87	758	16	1681
13. Neshaminy Creek	116	3	1050	49	0	93	170	14	1365
14. Crosswicks Creek	128	1	18	0	0	3	4	5	26
Total		9	7276	298	1	438	6388	31	14410

TABLE 4 List of fishes collected from the Delaware Bay Region. Type of species: M = Marine; B = Brackish (Sal. 1-10 ppt); F = Fresh. Primary activity in area: M = Migrant; SP = Spawning in Area; SF = Summer Feeding; WF = Winter Feeding; N = Nursery; R = Resident Species; ST = Stray

Species	Type of Species	Primary Activity in Area
PETROMYZONITIDAE - LAMPREYS		
Petromyzon marinus - Sea lamprey	M, B, F	M
CARCHARIIDAE - SANDSHARKS		
Carcharias taurus - Sandshark	M, B	SF
LAMNIDAE - MACKERAL SHARKS		
Alopias vulpinus - Thresher shark	M	SF
ODONTOSPIDIDAE - SAND TIGERS		
Odontaspis taurus - Sand Tigers	M	M
CARCHARHINIDAE - REQUIEM SHARKS		
Carcharhinus milberti - Sandbar shark	M	SF
C. obscurus - Dusky shark	M	ST
Mustelus canis - Smooth dogfish (Lewes)	M	SF
Prionace glauca - Blue shark	M	SF
Scoliodon terra and *novae* - Atlantic sharpnose shark	M	ST
SPHYRNIDAE - HAMMERHEAD SHARKS		

TABLE 4

Species	Type of Species	Primary Activity in Area
Sphyrna tiburo - Bonnethead	M	SF
S. zygaena - Smooth hammerhead	M	
TORPEDINIDAE - ELECTRIC RAYS		
Torpedo nobiliana - Atlantic torpedo	M	ST
SCYLIORHINIDAE - CAT SHARKS		
Scyliorhinus retifer - Chain dogfish	M	M
SQUALIDAE - DOGFISH SHARKS		
Squalus acanthias - Spiny dogfish	M	WF
SQUATINIDAE - ANGEL SHARKS		
Squatina dumerili - Atlantic angel shark	M	SF
RAJIDAE - SKATES		
Raja eglanteria - Clearnose skate	M	SF
R. erinacea - Little skate	M	WF
R. garmani - Rosette skate	M	ST
R. laevis - Barndoor skate	M	
R. ocellata - Winter skate	M	WF
R. radiata - Thorny skate	M	
DASYATIDAE - STINGRAYS		

TABLE 4 (cont.)

Species	Type of Species	Primary Activity in Area
Dasyatis centroura - Roughtail stingray	M	SF
D. sabina - Atlantic stingray (off Bowers)	M	
D. sayi - Bluntnose stingray	M	SF
Gymnura altavela - Spiny butterfly ray	M	
G. micrura - Smooth butterfly ray	M	
Urolophus jamaicensis - Yellow stingray	M	ST
MYLIOBATIDAE - EAGLE RAYS		
Myliobatis freminvillei - Bullnose ray	M	SF
Rhinoptera bonasus - Cownose ray	M	ST
CHIMAERIDAE - CHIMAERA		
Hydrolagus colliei - Ratfish	M	ST
ACIPENSERIDAE - STURGEONS		
Acipenser oxyrhyncus - Atlantic sturgeon	M, B, F	M
ELOPIDAE - TARPONS		
Megalops atlantica - tarpon	M	ST
ANGUILLIDAE - FRESHWATER EELS		
Anguilla rostrata - American eel	M, B, F	M, SF, N, R

TABLE 4 (cont.)

Species	Type of Species	Primary Activity in Area
CONGRIDAE - CONGER EELS		
Conger oceanicus - Conger eel	M	
CLUPEIDAE - HERRINGS		
Alosa aestivalis - Blueback herring	M, B, F	SP, N
A. mediocris - Hickory shad	M, B, F	M (adults), SF (young)
A. pseudoharengus - Alewife	M, B, F	SP, N
A. sapidissima - American shad	M, B, F	M
Brevoortia tyrannus - Atlantic menhaden	M, B, F	N, SF
Clupea harengus harengus - Atlantic herring	M, B	
Dorosoma cepedianum - Gizzard shad	F, B	R, SP
Etrumeus teres - Atlantic round herring	M, B?	
Opisthonema oglinum - Atlantic thread herring	M	
ENGRAULIDAE - ANCHOVIES		
Anchoa hepsetus - Striped anchovy	M, B	ST
A. mitchilli - Bay anchovy	M, B, F	SP?, N, SF
Engraulis eurystole - Silver anchovy	M, B	
UMBRIDAE - MUDMINNOWS		
Umbra pygmaea - Eastern mudminnow	F	ST

TA 4

Species	Type of Species	Primary Activity in Area
ESOCIDAE - PIKES		
Esox americanus - Redfin pickerel	F, B	R, SP
E. niger - Chain pickerel	F, B	R, SP
SYNODONTIDAE - LIZARD FISHES		
Synodus foetens - Inshore lizard fish	M	
CYPRINIDAE - MINNOWS AND CARPS		
Carassius auratus - Goldfish	F, B	R, SP?
Cyprinus carpio - Carp	F, B	R, SP
Exoglossum maxillingua - Cutlips minnow	F, B	R, SP
Hybognathus nuchalis - Silvery minnow	F, B	R, SP
Notemigonus crysoleucas - Golden shiner	F, B	R, SP
Notropis analostanus - Satinfin shiner	F	R, SP (upper crk lak
N. bifrenatus - Bridle shiner	M, B	WF
N. hudsonius - Spottail shiner	F, B	R, SP
Rhinichthys atratulus - Blacknose dace	F	ST
CATOSTOMIDAE		
Carpoides cyprinus - Quillback (C & D Canal)	F	ST
Catostomus commersoni - White sucker (upper marsh crks)	F	R, SP (upper creeks)

TABLE 4 (Cont.)

Species	Type of Species	Primary Activity in Area
Erimyzon oblongus - Creek chubsucker (upper marsh crks)	F	R, SP (upper creeks)
ICTALURIDAE - FRESHWATER CATFISHES		
Ictalurus catus - White catfish	F, B	R, SP
I. nebulosus - Brown bullhead	F, B	R, SP
I. punctatus - Channel catfish	F, B	R, SP
Noturus gyrinus - Tadpole madtom (upper Blackbird Crk)	F	R, SP (upper creeks)
BATRACHOIDIDAE - TOADFISHES		
Opsanus tau - Oyster toadfish	M, B	SF?
LOPHIIDAE - GOOSEFISHES		
Lophius americanus - Goosefish (dead on beach at Bayview)	M, B?	ST
GADIDAE - CODFISHES		
Enchelyopus cimbrius - Fourbeard rockling	M	ST
Gadus morhua - Atlantic cod	M	WF
Melanogrammus aeglefinus - haddock	M	WF
Merluccius bilinearis - Silver hake	M, B	
Pollachius virens - Pollock	M	
Urophycis chuss - Squirrel hake	M, B	
U. regius - Spotted hake	M, B	SF
U. tenuis - White hake	M, B	

TABLE 4 (cont.)

Species	Type of Species	Primary Activity in Area
EXOCOETIDAE - FLYINGFISHES AND HALFBEAKS		
Cypselurus heterurus - Atlantic flyingfish	M	ST
Hyporhamphus unifasciatus - Halfbeak (Lewes)	M, B	
BELONIDAE - NEEDLEFISHES		
Ablennes hians - Flat needlefish	M	
Hemiramphidae - Halfbeaks		
Hyporhamphus unifasciatus - Halfbeak	M	
Strongylura marina - Atlantic needlefish	M, B, F	N, SF
S. raphidoma - Houndfish	M	
CYPRINODONTIDAE - KILLIFISHES		
Cyprinodon variegatus - Sheepshead minnow	M, B, F	SF
Fundulus diaphanus - Banded killifish	F, B, M	R, SP
F. heteroclitus - Mummichog	B, F, M	R, SP
F. luciae - Spotfin killifish		
F. majalis - Striped killifish	M, B	SF
Lucania parva - Rainwater killifish	M, B	
POECILIIDAE - LIVEBEARERS		
Gambusia affinis - Mosquitofish	M, B, F	R, SP

TABLE 4 (Cont.)

Species	Type of Species	Primary Activity in Area
ATHERINIDAE - SILVERSIDES		
Membras martinica - Rough silverside	M, B, F	SF, SP?
Menidia beryllina - Tidewater silverside	B, F, M	R, SP
M. menidia - Atlantic silverside	M, B, F	R, SP
POLYMIXIIDAE - BEARDFISHES		
Polymixis lowei - Beardfish	M	ST
GASTEROSTEIDAE - STICKLEBACKS		
Apeltes quadracus - Fourspine stickleback	M, B, F	WF
Gasterosteus aculeatus - Threespine stickleback	M, B, F	WF
SYNGNATHIDAE - PIPEFISHES AND SEAHORSES		
Hippocampus erectus - Lined seahorse	M, B	ST
H. hudsonius - Lined seahorse	M, B	
H. obtusus - Offshore seahorse	M	ST
Syngnathus fuscus - Northern pipefish	M, B, F	N, SF
S. pelagicus - Sargassum pipefish	M	
CENTROPONIDAE - SNOOKS		
Centropomus undecimalis	M	
FISTULARIIDAE - CORNETFISHES		
Fistularia tabacaria - Cornetfish	M, B?	SF

TABL.. 4(cont.)

Species	Type of Species	Primary Activity in Area
CENTRISCIDAE - SNIPEFISHES		
<u>Macrorhamphosus</u> <u>scolopax</u> - Longspine snipefish	M	SF
SEPRANIDAE - SEA BASSES		
<u>Centropristes</u> <u>striatus</u> - Black sea bass	M, B?	SF
<u>Epinephelus</u> <u>niveatus</u> - Snowy grouper	M	ST
CARANGIDAE - JACKS AND POMPANOS		
<u>Caranx</u> <u>crysos</u> - Blue runner	M	
<u>C.</u> <u>hippos</u> - Crevalle jack	M, B, F	N, SF
<u>Decapterus</u> <u>macarellus</u> - Mackeral scad	M	ST
<u>C.</u> <u>punctatus</u> - Round scad	M	ST
<u>Selar</u> <u>crumenopthalmus</u> - Big eye scad	M	
<u>Selene</u> <u>vomer</u> - Lookdown	M, B	ST
<u>Seriola</u> <u>dumerili</u> - Greater amberjack	M	ST
<u>S.</u> <u>zonata</u> - Banded rudderfish	M	ST
<u>Trachinotus</u> <u>carolinus</u> - Pompano	M	M, S, F
<u>T.</u> <u>falcatus</u> - Permit (Slaughter Beach, Lewes)	M	
<u>Trachurus</u> <u>lathami</u> - Rough scad	M	
<u>Vomer</u> <u>setapinnis</u> - Atlantic moonfish	M	

TABLE 4 (Cont.)

Species	Type of Species	Primary Activity in Area
CORYPHAENIDAE - DOLPHINS		
Coryphaena hippurus - Dolphin	M	
POMADASYIDAE - GRUNTS		
Orthopristis chrysopterus - Pigfish	M	
SPARIDAE - PORGIES		
Lagodon rhomboides - Pinfish	M, B	ST
Stenotomus chrysops - Scup	M, B?	
EPHIPPIDAE - SPADEFISHES		
Chaetodipterus faber - Atlantic spadefish	M	ST
LUTJANIDAE - SNAPPERS		
Lutjanus griseus - Gray snapper	M, B, F	ST
Rhomboplites aurorubens - Vermilion snapper	M, B, F	ST
SCIAENIDAE - DRUMS		
Bairdiella chrysura - Silver perch	M, B, F	N, SF
Cynoscion regalis - Weakfish	M, B, F	N, SF
Leiostomus xanthurus - Spot	M, B, F	SF
Menticirrhus saxatilis - Northern kingfish	M, B	ST
Micropogon undulatus - Atlantic croaker	M, B, F	N, WF

TABL. 4(con..)

Species	Type of Species	Primary Activity in Area
Pogonias cromis - Black drum	M, B, F	N, SF
Sciaenops ocellata - Red drum	M, B, F?	
STROMATEIDAE - BUTTERFISHES		
Palinurichthys perciformis - Barrelfish	M	
Peprilus alepidotus - Harvestfish	M	
Poronotus triacanthus - Butterfish	M, B	SF
Psenes maculatus - Silver driftfish	M	
MUGILIDAE - MULLETS		
Mugil cephalus - Striped mulled	M, B, F	SF
M. curema - White mullet	M, B, F	ST
PHOLIDAE - GUNNELS		
Pholis gunnellus - Rock gunnel	[illegible]	
SPHYRAENIDAE - BARRACUDAS		
Sphyraena borealis - Northern sennet (Lewes)	M	
STICHAEIDAE - PRICKLEBACKS		
Ulvoria subbifurcata - Radiated shanny	M	
URANOSCOPIDAE - STARGAZERS		
Astroscopus y-graecum - Southern stargazer		
A. gur- -us - Northern stargazer	M, B	S

TABLE 4 (cont.)

Species	Type of Species	Primary Activity in Area
BLENNIIDAE - COMBTOOTH BLENNIES		
Chasmodes bosquianus - Striped blenny	M	
ANARHICHADIDAE		
Anarhichus lupus - Atlantic wolffish	M	ST
OPHIDIIDAE - CUSKEELS		
Rissola marginata - Striped Cuskeel	M, B	ST
ZOARCIDAE - EEL POUTS		
Macrozoarces americanus - Ocean pout	M	
GOBIIDAE - GOBIES		
Gobionellus boleosoma - Darter goby	M	
G. oceanicus - Highfin goby	M	
Gobiosoma bosci - Naked goby	M, B, F	N, SF
G. ginsburgi - Seaboard goby	N, B?	
Microgobius thalassinus - Green goby		
TRIGLIDAE - SEAROBINS		
Peristedion miniatum - Armored searobin	M	?SF
Prionotus carolinus - Northern searobin (off Bowers)	M	
P. evolans - Striped searobin	M, B	SF

TABLE 4 (cont.)

Species	Type of Species	Primary Activity in Area
COTTIDAE - SCULPINS		
Hemitripterus americanus - Sea raven	M	
Myoxocephalus aenaeus - Grubby		
M. octodecem spinosus - Long horn sculpin	M	
CYCLOPTERIDAE - LUMPFISHES AND SNAIL FISHES		
Liparis liparis - Striped Seasnail	M	ST
DACTYLOPTERIDAE - FLYING GURNARDS		
Dactylop teridae - Flying gurnard	M	
Dactylopterus volitans - Flying gurnard	M	ST
Citharichthys spilopterus - Bay whiff	M	
Paralichthys oblongus - Fourspot flounder	M, B	
AMMODYTIDAE - SAND LANCES		
Ammodytes americanus - American sand lance	M, B?	
CYNOGLOSSIDAE - TONGUEFISHES		
Symphurus plagiusa - Blackcheek tonguefish		
ECHENIDAE - REMORAS		
Echeneis naucrates - Sharksucker	M	ST
Remora osteochir - Marlin sucker	M	ST

TABLE (ont.)

Species	Type of Species	Primary Activity in Area
R. remora - Remora	M	ST
BOTHIDAE - LEFTEYE FLOUNDER		
Citharichthys spilopterus - Bay Whiff	M	
Etropus grossotus - Fringed flounder		
E. microstomus - Smallmouth flounder	M, B	SF
Paralichthys dentatus - Summer flounder	M, B	SF
P. oblongus - Fourspot flounder	M, B	
Scophthalmus aquosus - Windowpane	M, B	SF
PLEURONECTIDAE - RIGHTEYE FLOUNDER		
Glyptocephalue cynoglossus - Witch flounder	M	
Limanda ferruginea - Yellowtail flounder	M, B	
Pseudopleuronectes americanus - Winter flounder	M, B, F	N, SF
SOLEIDAE - SOLES		
Trinectes maculatus - Hogchoker	M, B, F	N, SF
CHAETODONTIDAE - BUTTERFLY FISHES		
Chaetodon ocellatus	M	
Holacanthus bermudensis - Blue anglefish	M	
H. ciliaris - Queen angelfish	M	

TABLE 4 (cont.)

Species	Type of Species	Primary Activity in Area
LABRIDAE - WRASSES		
Tautoga onitis - Tautog	M	SP
Tautogolabrus adspersus - Cunner	M	
SCARIDAE - PARROT FISHES		
Scarus guacamaia	M	
TRICHIURIDAE - CUTLASS FISHES		
Trichiurus lepturus - Atlantic cutlass fish	M	
SCOMBRIDAE - MACKERALS AND TUNAS		
Acanthocybium solanderi - Wahoo	M	
Scomber japonicus - Chub mackeral	M	
Scomberomorus cavalla - King mackeral	M	
Thunnus alalunga - Albacore	M	
T. thynnus - Bluefin tuna	M	
Euthynnus alletteratus - Little tuna		
Sarda sarda - Atlantic bonito	M	
Scomber scombrus - Atlantic mackeral	M, B	
ISTIOPHORIDAE - BILLFISHES		
Makaira albida - White marlin	M	ST

TABLE 4 (Cont.)

Species	Type of Species	Primary Activity in Area
M. nigricans - Blue marlin	M	ST
XIPHIIDAE - SWORDFISHES		
Xiphias gladius - Swordfishes	M	ST
BALISTIDAE - TRIGGERFISHES AND FILEFISHES		
Aluterus schoepfi - Orange filefish (dead in river)	M, B?	ST
Balistes capriscus - Gray triggerfish	M	
Monacanthus hispidus - Planehead filefish	M	
TETRAODONTIDAE - PUFFERS		
Lagocephalus laevitagus - Smooth puffer	M	
Sphaeroides maculatus - Northern puffer	M, B	ST
PERCICHTHYIDAE - TEMPERATE BASSES		
Morone americana - White perch	B, F, M	R, SP
M. saxatilis - Striped bass	M, B, F	M (adults), R?, N, SF
PRIACANTHIDAE - BIG EYES		
Pristigenys alta - Short big eye	M, B	
CENTRARCHIDAE - SUNFISHES		
Enneacanthus chaetodon - Blackbanded sunfish (C & D Canal)	F	ST

TABI 4(cont.)

Species	Type of Species	Primary Activity in Area
Lepomis auritus - Redbreast sunfish (upper Blackbird Creek)	F	R, SP (upper cre
L. gibbosus - Pumpkinseed	F, B	R, SP
L. macrochirus - Bluegill	F, B	R, SP (in creek la
Micropterus salmoides - Largemouth bass	F, B	R, SP (in creek la
Pomoxis annularis - White crappie	F, B	R, SP
P. nigromaculatus - Black crappie	F, B	R, SP
PERCIDAE - PERCHES		
Etheostoma fusiforme	F, B	
E. olmstedi - Tessellated darter	F, B	R, SP
Perca flavescens - Yellow perch	F, B	R, SP
POMATOMIDAE - BLUEFISHES		
Pomatomus saltatrix - Bluefish	M, B, F	R, SP
DIODONTIDAE - PORCUPINE FISHES		
Chilomycterus schoepfi - Striped Burrfish	M	
OSTRACIIDAE		
Ostracion diaphanum - Spiny boxfish	M, B	
MOLIDAE		
Mola - Ocean sunfish	M	SP

TABLE 5 List of fishes collected from the Delaware River and four marsh creeks in the vicinity of Artificial Island in June, 1968, to January, 1971. Those species taken outside of, but adjacent to, the study area have the locality noted in parentheses after the common name. Type of species: M = Marine; B = Brackish (Sal. 1-10 ppt); F = Fresh. Primary activity in area: M = Migrant; SP = Spawning in Area; SF = Summer Feeding; WF = Winter Feeding; N = Nursery; R = Resident Species; ST = Stray.

Species	Type of Species	Primary Activity in Area
PETROMYZONTIDAE - LAMPREYS		
Petromyzon marinus-Sea lamprey	M, B, F	M
CARCHARHINIDAE - REQUIEM SHARKS		
Sandbar shark		
Carcharhinus obscurus-Dusky shark	M	ST
Mustelus canis-Smooth dogfish (Lewes)	M	
DASYATIDAE - STINGRAYS		
Dasyatis sabina-Atlantic stingray (off Bowers)	M	
MYLIOBATIDAE - EAGLE RAYS		
Rhinoptera bonasus-Cownose ray	M	ST
ACIPENSERIDAE - STURGEONS		
Acipenser oxyrhyncus-Atlantic sturgeon	M, B, F	M
ANGUILLIDAE - FRESHWATER EELS		
Anguilla rostrata-American eel	M, B, F	M, SF, N, R
CLUPEIDAE - HERRINGS		
Alosa aestivalis-Blueback herring	M, B, F	SP, N
Alosa mediocris-Hickory shad	M, B, F	M (adults), SF (young)
Alosa pseudoharengus-Alewife	M, B, F	SP, N
Alosa sapidissima-American shad	M, B, F	M
Brevoortia tyrannus-Atlantic menhaden	M, B, F	N, SF
Dorosoma cepedianum-Gizzard shad	F, B	R, SP

(Thomas 1971)

TABLE 5 continued

Species	Type of Species	Primary Activity in Area
ENGRAULIDAE - ANCHOVIES		
Anchoa hepsetus-Striped anchovy	M, B	ST
Anchoa mitchilli-Bay anchovy	M, B, F	SP?, N, SF
UMBRIDAE - MUDMINNOWS		
Umbra pygmacea-Eastern mudminnow	F	ST
ESOCIDAE - PIKES		
Esox americanus-Redfin pickerel	F, B	R, SP
Esox niger-Chain pickerel	F, B	R, SP
CYPRINIDAE - MINNOWS AND CARPS		
Carassius auratus-Goldfish	F, B	R, SP?
Cyprinus carpio-Carp	F, B	R, SP
Hybognathus nuchalis-Silvery minnow	F, B	R, SP
Notemigonus crysoleucas-Golden shiner	F, B	R, SP
Notropis analostanus-Satinfin shiner	F	R, SP (upper crk. lakes)
Notropis hudsonius-Spottail shiner	F, B	R, SP
Rhinichthys atratulus-Blacknose dace	F	ST
CATOSTOMIDAE		
Carpoides cyprinus-Quillback (C&D Canal)	F	ST
Catostomus commersoni-White sucker (upper marsh crks.)	F	R, SP (upper creeks)
Erimyzon oblongus-Creek chubsucker (upper marsh crks.)	F	R, SP (upper creeks)
ICTALURIDAE - FRESHWATER CATFISHES		
Ictalurus catus-White catfish	F, B	R, SP
Ictalurus nebulosus-Brown bullhead	F, B	R, SP
Ictalurus punctatus-Channel catfish	F, B	R, SP
Noturus gyrinus-Tadpole madtom (upper Blackbird Crk.)	F	R, SP (upper creeks)
BATRACHOIDIDAE - TOADFISHES		
Opsanus tau-Oyster toadfish	M, B	SF?

(Thomas 1971)

TABLE 5 continued

Species	Type of Species	Primary Activity in Area
LOPHIIDAE - GOOSEFISHES		
Lophius americanus-Goosefish (Dead on beach at Bayview)	M, B?	ST
GADIDAE - CODFISHES		
Urophycis regius-Spotted hake	M, B	SP
OPHIDIIDAE - CUSK-EELS AND BROTULAS		
Rissola marginata-Striped cusk-eel	M, B	ST
EXOCOETIDAE - FLYINGFISHES AND HALFBEAKS		
Hyporhamphus unifasciatus-Halfbeak (Lewes)	M	
BELONIDAE - NEEDLEFISHES		
Strongylura marina-Atlantic needlefish	M, B, F	N, SP
CYPRINODONTIDAE - KILLIFISHES		
Cyprinodon variegatus-Sheepshead minnow	M, B, F	SF
Fundulus diaphanus-Banded Killifish	F, B, M	R, SP
Fundulus heteroclitus-Mummichog	B, F, M	R, SP
Fundulus majalis-Striped Killifish	M, B	SF
POECILIIDAE - LIVEBEARERS		
Gambusia affinis-Mosquitofish	M, B, F	R, SP
ATHERINIDAE - SILVERSIDES		
Membras martinica-Rough silverside	M, B, F	SF, SP?
Menidia beryllina-Tidewater silverside	B, F, M	R, SP
Menidia menidia-Atlantic silverside	M, B, F	R, SP
GASTEROSTEIDAE - STICKLEBACKS		
Apeltes quadracus-Fourspine stickleback	M, B, F	WF
Gasterosteus aculeatus-Threespine stickleback	M, B, F	WF

(Thomas 1971)

TABLE 5 continued

Species	Type of Species	Primary Activity in Area
SYNGNATHIDAE - PIPEFISHES AND SEAHORSES		
Hippocampus erectus -Lined seahorse	M, B	ST
Syngnathus fuscus-Northern pipefish	M, B, F	N, SF
PERCICHTHYIDAE - TEMPERATE BASSES		
Morone americana-White perch	B, F, M	R, SP
Morone saxatilis-Striped bass	M, B, F	M (adults), R?, N, SF
CENTRARCHIDAE - SUNFISHES		
Enneacanthus chaetodon-Blackbanded sunfish (C&D Canal)	F	ST
Lepomis auritus-Redbreast sunfish (upper Blackbird Creek)	F	R, SP (upper creeks)
Lepomis gibbosus-Pumpkinseed	F, B	R, SP
Lepomis macrochirus-Bluegill	F, B	R, SP (in creek lakes)
Micropterus salmoides-Largemouth bass	F, B	R, SP (in creek lakes)
Pomoxis annularis-White crappie	F, B	R, SP
Pomoxis nigromaculatus-Black crappie	F, B	R, SP
PERCIDAE - PERCHES		
Etheostoma olmstedi-Tessellated darter	F, B	R, SP
Perca flavescens-Yellow perch	F, B	R, SP
POMATOMIDAE - BLUEFISHES		
Pomatomus saltatrix-Bluefish	M, B, F	N, SF
CARANGIDAE - JACKS AND POMPANOS		
Caranx hippos-Crevalle jack	M, B, F	N, SF
Selene vomer-Lookdown	M, B	ST
Trachinotus carolinus-Florida pompano (Slaughter Beach,Lewes)	M	
Trachinotus falcatus-Permit (Slaughter Beach, Lewes)	M	
Vomer setapinnis-Atlantic moonfish	M	
LUTJANIDAE - SNAPPERS		
Lutjanus griseus-Gray snapper	M, B, F	ST

(Thomas 1971)

TABLE 5 continued

Species	Type of Species	Primary Activity in Area
SPARIDAE - PORGIES		
Lagodon rhomboides-Pinfish (Woodland Beach)	M, B	ST
SCIAENIDAE - DRUMS		
Bairdiella chrysura-Silver perch	M, B, F	N, SF
Cynoscion regalis-Weakfish	M, B, F	N, SF
Leiostomus xanthurus-Spot	M, B, F	SF
Menticirrhus saxatilis-Northern kingfish	M, B	ST
Micropogon undulatus-Atlantic croaker	M, B, F	N, WF
Pogonias cromis-Black drum	M, B, F	N, SF
MUGILIDAE - MULLETS		
Mugil cephalus-Striped mullet	M, B, F	SF
Mugil curema-White mullet	M, B, F	ST
SPHYRAENIDAE - BARRACUDAS		
Sphyraena borealis-Northern sennet (Lewes)	M	
URANOSCOPIDAE - STARGAZERS		
Astroscopus guttatus-Northern stargazer	M, B	ST
GOBIIDAE - GOBIES		
Gobiosoma bosci-Naked goby	M, B, F	N, SF
STROMATEIDAE - BUTTERFISHES		
Peprilus triacanthus-Butterfish	M, B	SF
TRIGLIDAE - SEAROBINS		
Prionotus carolinus-Northern searobin (off Bowers)	M	
Prionotus evolans-Striped searobin	M, B	SF

(Thomas 1971)

TABLE 5 continued

Species	Type of Species	Primary Activity in Area
BOTHIDAE - LEFTEYE FLOUNDER		
Etropus microstomus-Smallmouth flounder	M, B	ST
Paralichthys dentatus-Summer flounder	M, B	ST
Scophthalmus aquosus-Windowpane	M, B	ST
PLEURONECTIDAE - RIGHTEYE FLOUNDER		
Pseudopleuronectes americanus-Winter flounder	M, B, F	N, SF
SOLEIDAE - SOLES		
Trinectes maculatus-Hogchoker	M, B, F	N, SF
BALISTIDAE - TRIGGERFISHES AND FILEFISHES		
Aluterus schoepfi-Orange filefish (Dead in river)	M, B?	ST
TETRAODONTIDAE - PUFFERS		
Sphaeroides maculatus-Northern puffer	M, B	ST

(Thomas 1971)

TABLE 6 Fish catch composition in Delaware Bay by years and for the tota sampling period. 1966 was only sampled from August through December.

Species	1966 #	1966 %	1967 #	1967 %	1968 #	1968 %	1969 #	1969 %	1970 #	1970 %	Total Period #	Total Period %
Sand Shark	2	0.01	14	0.04	3	0.01	2	0.01	1	0.01	22	0.02
Sandbar Shark	14	0.04	37	0.10	1	0.00	4	0.02	4	0.02	60	0.04
Smooth Dogfish	652	1.83	799	2.09	637	2.85	605	2.74	643	2.74	643	3.61
Spiny Dogfish	84	0.24	125	0.33	51	0.23	49	0.22	105	0.59	414	0.30
Atlantic Angel Shark	1	0.00	-	-	2	0.01	-	-	1	0.01	4	0.00
Clearnose Skate	592	1.66	1087	2.84	352	1.57	231	1.04	109	0.61	2271	1.74
Little Skate	19	0.05	49	0.13	63	0.28	34	0.15	52	0.29	217	0.16
Winter Skate	-	-	29	0.08	2	0.01	-	-	1	0.01	32	0.02
Roughtail Stingray	77	0.22	81	0.21	112	0.50	158	0.71	138	0.78	566	0.42
Bluntnose Stingray	66	0.19	72	0.19	4	0.02	7	0.03	82	0.46	231	0.17
Smooth Butterfly Ray	-	-	2	0.01	-	-	6	0.03	-	-	8	0.01
Spiny Butterfly Ray	6	0.02	-	-	3	0.01	1	0.00	1	0.01	11	0.01
Bullnose Ray	54	0.15	123	0.32	72	0.32	102	0.46	104	0.58	455	0.33
Cownose Ray	-	-	-	-	-	-	44	0.20	-	-	44	0.03
Atlantic Sturgeon	2	0.01	-	-	-	-	-	-	-	-	2	0.00
Blueback Herring	-	-	5	0.01	5	0.02	-	-	9	0.05	19	0.01
Hickory Shad	-	-	45	0.12	1	0.00	-	-	6	0.03	52	0.04
Alewife	21	0.06	59	0.15	27	0.12	15	0.07	19	0.11	141	0.10
Atlantic Menhaden	-	-	23	0.06	23	0.10	11	0.05	13	0.07	70	0.05
Atlantic Herring	1	0.00	464	1.21	344	1.54	350	1.58	88	0.49	1247	0.92
Gizzard Shad	-	-	4	0.01	4	0.02	-	-	-	-	8	0.01
Striped Anchovey	1	0.00	8	0.02	2	0.01	-	-	14	0.08	25	0.02
Bay Anchovey	24	0.07	1	0.00	1	0.00	4	0.02	7	0.04	37	0.03
Conger Eel	1	0.00	-	-	-	-	-	-	1	0.01	2	0.00
Striped Killifish	-	-	-	-	1	0.00	-	-	-	-	1	0.00
Silver Hake	41	0.12	549	1.44	481	2.15	69	0.31	27	0.15	1167	0.86
Squirrel Hake	89	0.25	838	2.19	145	0.65	38	0.17	58	0.33	1168	0.86
Spotted Hake	48	0.13	1311	3.43	471	2.10	81	0.37	266	1.50	2177	1.60
Threespine Stickleback	-	-	-	-	2	0.01	-	-	-	-	2	0.00
Black Seabass	5	0.01	10	0.03	5	0.02	23	0.10	18	0.10	61	0.04
White Perch	113	0.32	485	1.27	750	3.35	6	0.03	17	0.10	1371	1.01

TABLE 6 (cont.)

Species	1966 #	1966 %	1967 #	1967 %	1968 #	1968 %	1969 #	1969 %	1970 #	1970 %	Total Period #	Total Period %
Striped Bass	1	0.00	58	0.15	82	0.37	1	0.00	11	0.06	153	0.11
Snowy Grouper	-	-	-	-	-	-	1	0.00	-	-	1	0.00
Bluefish	20	0.06	7	0.02	2	0.01	3	0.01	11	0.06	43	0.03
Blue Runner	-	-	2	0.01	4	0.02	2	0.01	-	-	8	0.01
Lookdown	-	-	5	0.01	-	-	3	0.01	1	0.01	9	0.01
Pig Fish	3	0.01	2	0.01	-	-	-	-	3	0.02	8	0.01
Silver Perch	137	0.39	24	0.06	13	0.06	47	0.21	224	1.26	445	0.33
Weakfish	11315	31.82	10572	27.64	6083	27.18	7841	35.46	6464	36.34	42275	31.06
Northern Kingfish	136	0.38	119	0.31	117	0.52	65	0.29	63	0.35	500	0.37
Spot	1731	4.87	4	0.01	-	-	1683	7.61	76	0.43	3494	2.57
Black Drum	1838	5.17	79	0.21	10	0.04	143	0.65	116	0.65	2186	1.61
Atlantic Croaker	-	-	-	-	-	-	-	-	4	0.02	4	0.00
Scup	5253	14.77	9650	25.23	593	2.65	445	2.01	1699	9.55	17640	12.96
Tautog	2	0.01	19	0.05	1	0.00	8	0.04	5	0.03	35	0.03
Northern Searobin	808	2.27	2225	5.82	1009	4.51	585	2.65	405	2.28	5032	3.70
Striped Searobin	106	0.30	303	0.79	159	0.71	158	0.71	324	1.82	1050	0.77
Sea Raven	-	-	1	0.00	-	-	-	-	-	-	1	0.00
Grubby	-	-	-	-	5	0.02	-	-	1	0.01	6	0.00
Longhorn Sculpin	6	0.02	495	1.29	1330	5.94	403	1.82	251	1.41	2485	1.83
Sea Snail	-	-	-	-	1	0.00	1	0.00	-	-	2	0.00
Northern Stargazer	22	0.06	2	0.01	-	-	1	0.00	-	-	25	0.02
Ocean Pout	-	-	-	-	10	0.04	7	0.03	7	0.04	24	0.02
Striped Cusk-Eel	-	-	-	-	13	0.06	-	-	-	-	13	0.01
Butterfish	52	0.15	1115	2.91	371	1.66	17	0.08	310	1.74	1865	1.37
Striped Mullet	-	-	-	-	-	-	1	0.00	1	0.01	2	0.00
Fringed Flounder	20	0.06	29	0.08	82	0.37	10	0.05	26	0.15	167	0.12
Summer Flounder	219	0.62	161	0.42	88	0.39	135	0.61	61	0.34	664	0.49
Fourspot Flounder	5	0.01	3	0.01	8	0.04	3	0.01	2	0.01	21	0.02
Windowpane	1087	3.06	1534	4.01	1619	7.23	964	4.36	827	4.65	6031	4.43
Winter Flounder	5	0.01	277	0.72	188	0.84	69	0.31	74	0.42	613	0.45
Hogchoker	8565	24.09	4522	11.82	6391	28.56	6778	30.65	4628	26.02	30884	22.69
Orange Filefish	1	0.00	1	0.00	-	-	1	0.00	8	0.04	11	0.01
Planehead Filefish	-	-	-	-	1	0.00	1	0.00	-	-	2	0.00

TABLE 6 (cont.)

Species	1966 #	1966 %	1967 #	1967 %	1968 #	1968 %	1969 #	1969 %	1970 #	1970 %	Total Period #	Total Period %
Northern Puffer	842	2.37	563	1.47	581	2.60	427	1.93	125	0.70	2538	1.86
Striped Burrfish	8	0.02	3	0.01	4	0.02	9	0.04	2	0.01	26	0.02
Oyster Toadfish	1465	4.12	248	0.65	47	0.21	459	2.08	271	1.52	2490	1.83
Goosefish	1	0.00	8	0.02	3	0.01	4	0.02	3	0.02	19	0.01
TOTAL	35561	100.00	38251	100.00	22379	100.00	22115	100.00	17787	100.00	136093	100.00

(Daiber and Smith 1971)

TABLE 7 Streams Known to Have Anadromous Clupeid Spawning Runs in Salem, Cumberland and Cape May Counties, New Jersey

Gloucester and Salem Counties - Delaware River Drainage

Oldmans Creek-alewife

Salem County-Delaware River Drainage

Beaver Creek-alewife - Oldmans Creek Drainage
Fenwick Creek-alewife - Salem River Drainage
Mannington Creek-alewife - Salem River Drainage
Salem River-alewife
Deep Run-alewife - Alloway Creek Drainage
Buckshutem Creek-alewife - Maurice River Drainage
Menantico Creek-alewife - Maurice River Drainage
Greenies Sandwash-alewife - Maurice River Drainage
Hankins Brook-alewife - Maurice River Drainage
White Marsh Run-alewife - Maurice River Drainage
Maurice River-blueback
Raceway-alewife - Maurice River Drainage
Maurice River-alewife

Cumberland and Cape May Counties-Delaware Bay Drainage

West Creek-alewife - Delaware Bay Drainage
Alloway Creek-alewife

Salem and Cumberland Counties-Delaware River Drive

Raccoon Ditch-alewife - Stow Creek Drainage
Stow Creek-alewife
Mill Creek-blueback - Cohansey River Drainage
Mill Creek-alewife - Cohansey River Drainage
Cohansey River-blueback
Cohansey River-alewife
Cedar Creek-blueback
Cedar Creek-alewife
Muskee Creek-alewife - Maurice River Drainage
Manumuskin River-alewife - Maurice River Drainage

Table 8

List of species obtained from transect samples in Delaware Bay during 1972 and 1973

	Feeding* Type	Transects 1-13	Transects 14-26
Phylum Cnidaria			
Class Hydrozoa			
Order Hydroida			
Family Hydractiniidae			
Hydractinia echinata (Fleming 1828)	SF		x
Family Campanulariidae			
Hartlaubella gelatinosa (Pallas 1766)	SF	x	
Family Sertulariidae			
Sertularia argentea Linne 1758	SF	x	
Family Plumulariidae			
Schizotricha tenella (Verrill 1874)	SF	x	
Class Anthozoa			
Order Actinaria			
Family Diadumenidae			
Diadumene leucolena (Verrill 1866)	SF	x	
Phylum Rhynchocoela			
Class Anopla			
Order Heteronemertini			
Family Lineidae			
Cerebratulus lacteus (Leidy 1851)	C	x	x
Micrura leidyi	C	x	
Class Unknown			
Nemertea sp.	C	x	x
Phylum Annelida			
Family Ampharetidae			
Asabellides oculatus (Webster 1879)	DF	x	x
Melinna sp. cf. *M. maculata*	DF	x	
Asabellides sp. cf. *A. oculatus*	DF	x	
? *Asabellides*	DF		x
Ampharetidae sp. 1	DF		x
Family Arabellidae			
Arabella iricolor (Montagu 1804)	O		x
Drilonereis longa Webster 1879	O	x	x
Drilonereis magna Webster and Benedict 1887	O		x
Family Capitellidae			
Capitella capitata (Fabricius 1780)	DF	x	x
Heteromastus filiformis (Claparede 1864)	DF	x	x

Table 8 (cont.)

	Feeding Type	Transects 1-13	Transects 14-26
Family Cirratulidae			
Caulleriella sp. 2	DF		x
Tharyx sp. 2	DF	x	x
Cirriformia sp. cf. C. grandis	DF	x	
? Chaetozone	DF		x
Family Eunicidae			
Marphysa sanguinea (Montagu 1815)	DF		x
Family Glyceridae			
Glycera americana Leidy 1855	C	x	x
Glycera capitata Oersted 1843	C		x
Glycera dibranchiata Ehlers 1868	C	x	x
Glycera robusta Ehlers 1868	C	x	
Family Goniadidae			
Glycinde solitaria (Webster 1880)	C	x	x
Family Hesionidae			
Microphthalmus aberrans (Webster and Benedict 1887)	C		x
Family Lumbrineridae			
Lumbrineris acuta (Verrill 1875)	DF	x	
Lumbrineris tenuis (Verrill 1873)	DF	x	x
Lumbrineris sp. cf. L. tenuis (Verrill 1873)	DF	x	
Family Magelonidae			
Magelona sp. 1	DF	x	
Magelona sp. 2	DF		x
Magelona sp. 4	DF	x	
Family Maldanidae			
Clymenella sp. cf. C. torquata (Leidy 1855)	DF	x	
Family Nephtyidae			
Nephtys bucera Ehlers 1868	O		x
Nephtys picta Ehlers 1868	O	x	x
Family Nereidae			
Nereis (Neanthes) succinea Frey and Leuckart 1847	O	x	x
Family Opheliidae			
Ophelia bicornis Savigny 1818	DF		x
Travisia carnea Verrill 1873	DF		x
Family Orbiniidae			
Haploscoloplos acutus (Verrill 1873)	DF		x
Haploscoloplos fragilis (Verrill 1873)	DF	x	x
Haploscoloplos robustus (Verrill 1873)	DF	x	x
Orbinia ornatus (Verrill 1873)	DF	x	
Scoloplos sp.	DF	x	
Family Paraonidae			
Aricidea sp.	DF		x
Aricidea cerruti Laubier 1967	DF		x
Paradoneis (Paraoinides) lyra Southern 1914	DF	x	

Table 8 (cont.)

	Feeding Type	Transects 1-13	Transects 14-26
Family Pectinariidae			
Pectinaria gouldii Verrill 1873	DF	x	
Family Phyllodocidae			
Eteone heteropoda Hartman 1951	O	x	x
Eteone lactea Claparede 1868	O		x
Eteone longa (Fabricius 1780)	O		x
Eumida sanguinea (Oersted 1843)	O	x	
Paranaitis kosteriensis (Malmgren 1867)	C		x
Phyllodoce arenae Webster 1880	C		x
Family Polynoidae			
Harmothoe sp. cf. *H. extenuata* (Grube 1840)	C	x	
Harmothoe (Lagisca) extenuata (Grube 1840)	C	x	x
Lepidonotus squamatus (Linnaeus 1756)	C		x
Lepidonotus sublevis Verrill 1873	C	x	x
Family Sabellaridae			
Sabellaria vulgaris Verrill 1873	SF	x	x
Family Sabellidae			
Potamilla reniformis (Leuchart 1849)	SF		x
Family Serpulidae			
Hydroides dianthus (Verrill 1873)	SF		x
Family Sigalionidae			
Sthenelais (denticulatum)	C	x	
Sigalion sp.	C	x	
Family Spionidae			
Polydora ligni Webster 1879	DF	x	x
Polydora socialis (Schmarda 1861)	DF		x
Polydora websteri Hartman 1943	DF		x
Scolecolepides viridis (Verrill 1873)	DF	x	x
Scololepis squamata (O.F. Muller 1806)	DF		x
Spiophanes bombyx (Claparede 1870)	DF	x	x
Streblospio benedicti Webster 1879	DF	x	x
Family Syllidae			
Exogone verugera (Claparede 1868)	O	x	
Parapionosyllis longicirrata Webster and Benedict 1884)	O		x
Proceraea cornuta (Agassiz 1863)	O		x
Family Terebellidae			
Polycirrus eximius (Leidy 1855)	DF		x
Class Oligochaeta			
Oligochaeta	DF	x	
Phylum Mollusca			
Class Gastropoda			
Order Mesogastropoda			
Family Epitoniidae			
Epitonium rupicola (Kurtz 1860)	C	x	
Family Calyptraeidae			
Crepidula fornicata (Linne 1758)	SF		x
Crepidula convexa Say 1822	SF	x	x
Crepidula plana Say 1822	SF		x

Table 8 (cont.)

	Feeding Type	Transects 1-13	Transects 14-26
Family Naticacea			
Lunatia heros (Say 1822)	C		x
Order Neogastropoda			
Family Melongenidae			
Busycon carica (Gmelin 1791)	C		x
Family Nassariidae			
Nassarius trivittatus (Say 1822)	C	x	x
Ilyanassa obsoletus (Say 1822)	C	x	x
Family Marginellidae			
Marginella roscida Redfield 1860	C	x	
Order Tectibranchia			
Family Pyramidellidae			
Sayella fusca (C.B. Adams 1839)	ectoparasitic		x
Order Nudibranchia			
Family Corambella			
Dorodella obscura Verrill 1870	C	x	x
Class Bivalvia			
Order Protobranchia			
Family Nuculidae			
Nucula proxima Say 1822	DF	x	x
Yoldia limatula Say 1831	DF	x	x
Order Filibranchia			
Family Arcidae			
Anadara ovalis (Bruguiere 1789)	SF		x
Family Mytilidae			
Geukensia demissa (Dillwyn 1817)	SF		x
Mytilus edulis Linne 1758	SF		x
Family Ostreidae			
Crassostrea virginica (Gmelin 1791)	SF	x	x
Order Eulamellibranchia			
Family Carditidae			
Cyclocardia borealis (Conrad 1831)	SF	x	
Family Leptonidae			
Mysella planulata (Stimpson 1857)	SF		x
Family Veneridae			
Mercenaria mercenaria (Linne 1758)	SF	x	x
Gemma gemma (Totten 1834)	SF	x	x
Family Tellinidae			
Tellina agilis Stimpson 1857	DF	x	x
Macoma balthica (Linne 1758)	DF	x	x
Family Solenidae			
Ensis directus Conrad 1843	SF	x	x
Family Mactridae			
Spisula solidissima (Dillwyn 1817)	SF	x	x
Mulinia lateralis (Say 1822)	SF	x	x
Family Myacidae			
Mya arenaria Linne 1758	SF	x	x

Table 8 (cont.)

	Feeding Type	Transects 1-13	Transects 14-26
Family Corbulidae			
Corbula contracta Say 1822	SF	x	x
Family Lyonsiidae			
Lyonsia hyalina Conrad 1831	SF	x	x
Family Pandoridae			
Pandora gouldiana Dall 1886	SF		x
Phylum Arthropoda			
Class Merostomata			
Limulus polyphemus (Linne 1758)	C		x
Class Pycnogonida			
Family Pallenidae			
Tanystylum orbiculare Wilson 1878	DF	x	x
Class Crustacea			
Subclass Cirripedia			
Order Thoracica			
Family Balanidae			
Balanus (Balanus) improvisus Darwin 1854	SF		x
Balanus (Semibalanus) balanoides (Linne)	SF		x
Subclass Malacostraca			
Order Mysidacea			
Family Mysidae			
Neomysis americana (S.I. Smith 1873)	SF	x	x
Order Cumacea			
Family Diastylidae			
Oxyurostylis smithi Calman 1912	DF		x
Order Isopoda			
Family Anthuridae			
Cyathura polita (Stimpson 1855)	O	x	x
Ptilanthura tenuis Harger 1878	O		x
Cyathura burbancki Frankenberg 1965	O		x
Family Idoteidae			
Chiridotea nigrescens Wigley 1961	DF		x
Edotea triloba (Say 1818)	DF		x
Order Amphipoda			
Family Ampeliscidae			
Ampelisca abdita Mills 1964	DF	x	x
Ampelisca verrilli Mills 1967	DF	x	x
Family Ampithoidae			
Ampithoidae sp.	DF	x	
Family Aoridae			
Lembos smithi (Holmes 1905)	DF		x
Family Bateidae			
Batea catharinensis Fr. Muller 1865	DF	x	
Family Corophiidae			
Corophium insidiosum Crawford 1937	DF	x	x
Corophium lacustre Vanhoffen 1911	DF	x	
Corophium tuberculatum Shoemaker 1934	DF	x	x
Erichthonius brasiliensis Dana 1853	DF	x	x

Table 8 (cont.)

	Feeding Type	Transects 1-13	Transects 14-26
Family Corophiidae (cont.)			
Unciola irrorata Say 1818	DF	x	
Unciola serrata Shoemaker 1945	DF	x	x
Unciola dissimilis Shoemaker 1945	DF	x	
Corophium simile Shoemaker 1934	DF	x	x
Family Gammaridae			
Gammarus mucronatus Say 1818	DF	x	x
Elasmopus laevis (Smith 1871)	DF		x
Melita nitida Smith 1873	DF	x	x
Family Haustoriidae			
Parahaustorius attenuatus Bousfield 1965	DF	x	
Parahaustorius longimerus Bousfield 1965	DF	x	
Protohaustorius wigleyi Bousfield 1965	DF	x	x
Protohaustorius deichmannae Bousfield 1965	DF	x	
Acanthohaustorius millsi Bousfield 1965	DF	x	x
Acanthohaustorius intermedius Bousfield 1965	DF		x
Family Lysianassidae			
Lysianopsis alba Holmes 1905	DF	x	
Family Phoxocephalidae			
Paraphoxus spinosus Holmes 1903	DF		x
Trichophoxus epistomus (Shoemaker 1938)	DF	x	
Family Pleustidae			
Parapleustes aestuarius Watling and Maurer 1973	DF	x	x
Family Stenothoidae			
Parametopella cypris (Holmes 1905)	DF		x
Family Caprellidae			
Paracaprella tenuis Mayer 1903	SF	x	x
Order Decapoda			
Family Crangonidae			
Crangon septemspinosa (Say 1818)	DF	x	x
Family Callianassidae			
Callianassa sp. cf. C. atlantica	DF	x	
Family Paguridae			
Pagurus longicarpus Say 1817	DF	x	x
Family Cancridae			
Cancer irroratus Say 1817	C	x	x
Family Xanthidae			
Xanthid sp.	C	x	
Eurypanopeus depressus (Smith 1869)	C	x	x
Neopanope texana sayi (Smith 1869)	C	x	x
Rhithropanopeus harrisi (Gould 1841)	C		x
Family Pinnotheridae			
Pinnotheres maculatus Say 1818	commensal		x
Pinnixa sayana Stimpson 1860	DF	x	x

Table 8 (cont.)

	Feeding Type	Transects 1-13	Transects 14-26
Phylum Ectoprocta			
Class Gymnolaemata			
Order Ctenostomata			
Family Alcyonidiidae			
Alcyonidium polyoum (Hassall 1841)	SF	x	x
Alcyonidium verrilli Osburn 1912	SF		x
Family Nolellidae			
Anguinella palmata Van Beneden 1844	SF	x	
Family Flustrellidae			
Flustrellidra hispida (Fabricius 1780)	SF	x	
Family Vesiculariidae			
Bowerbankia gracilis Leidy 1855	SF	x	
Family Triticellidae			
Triticella elongata (Osburn 1912)	SF	x	
Order Cheilostomata			
Family Membraniporidae			
Membranipora tenuis Desor 1848	SF	x	x
Membranipora tuberculata (Bosc 1802)	SF		x
Conopeum tenuissimum (Canu 1908)	SF	x	x
Family Electridae			
Electra hastingsae Marcus 1938	SF	x	x
Family Schizoporellidae			
Schizoporella errata (Watess 1878)	SF		x
Family Microporellidae			
Microporella ciliata (Pallas 1766)	SF		x
Phylum Echinodermata			
Class Echinoidea			
Order Diadematoida			
Family Echinarachnidae			
Echinarachnius parma (Lamark 1816)	SF		x

Source: Watling, Maurer and Wethe, 1976

*SF = Suspension Feeder
DF = Deposit Feeder
C = Carnivore
O = Omnivore

Table 9 Commercial Fish and Shellfish Landings in Delaware Bay and River, 1955-1977*

	New Jersey		Delaware		Total	
Year	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars
1955	6,027,125	2,611,829	6,359,700	1,290,374	12,386,825	3,902,203
1956	6,229,300	2,963,116	6,280,700	1,182,417	12,510,000	4,145,533
1957	4,364,100	1,874,694	10,035,500	3,890,741	14,399,600	5,765,435
1958	2,437,200	664,939	N/A	N/A	-	-
1959	1,507,040	277,194	N/A	N/A	-	-
1960	2,076,700	294,928	2,622,250	383,940	4,698,950	678,868
1961	3,267,200	967,519	1,511,400	257,001	4,778,600	1,224,520
1962	3,109,000	1,545,010	2,647,800	317,431	5,756,800	1,862,441
1963	2,188,100	658,494	1,036,900	161,243	2,846,594	819,737
1964	2,489,700	1,087,365	911,400	183,972	3,401,100	1,271,337
1965	2,133,700	767,541	994,400	122,468	3,128,100	890,009
1966	1,858,500	839,873	841,500	89,593	2,700,000	929,466
1967	2,444,300	1,080,500	449,800	82,798	2,893,800	1,163,298
1968	1,934,100	1,091,083	396,300	98,147	2,330,400	1,189,230
1969	1,874,100	889,716	675,800	112,587	2,549,900	788,387
1970	1,686,900	624,945	1,066,200	281,036	2,753,100	905,981
1971	2,173,800	842,036	1,723,200	514,964	3,897,000	1,357,000
1972	3,390,500	1,694,665	3,822,800	1,249,739	7,213,300	2,944,404
1973	4,178,600	1,912,128	3,638,700	1,264,597	7,817,300	3,176,725
1) 1974	45,948,900	2,716,196	2,930,300	751,270	48,879,200	3,467,466
1975	5,234,200	1,551,321	4,230,200	1,160,831	9,464,400	2,712,152
1976	2,384,700	2,111,317	6,321,900	1,683,187	8,706,600	3,794,504
1977	2,008,300	1,577,672	2,045,300	704,206	4,053,600	2,281,878

N/A - Not available

1) - Menhaden landings for this year were 42,186,800 pounds valued at $1,060,861.

* - Source: National Marine Fisheries Service, Department of Commerce

Table 10 Commercial Fish and Shellfish Landings in Delaware Bay and River, 1977*

Species	New Jersey Pounds	New Jersey Dollars	Delaware Pounds	Delaware Dollars	Total Pounds	Total Dollars
Alewives	1,000	66	-	-	1,000	66
Bluefish	33,200	3,252	31,100	3,081	64,300	6,333
Butterfish	-	-	100	24	100	24
Carp	34,700	3,431	28,000	2,520	62,700	5,951
Catfish	3,600	542	10,100	1,414	13,700	1,956
Croaker	3,300	514	8,900	1,841	12,200	2,355
Drum, red	-	-	200	13	200	13
Drum, black	11,000	1,649	-	-	11,000	1,649
Eels, common	17,800	6,671	95,900	49,281	113,700	55,952
Fluke	300	124	4,500	2,111	4,800	2,235
Herring, sea	1,100	41	-	-	1,100	41
Mackerel, Atlantic	-	-	500	77	500	77
Menhaden	41,900	2,016	24,600	984	66,500	3,000
Sea trout, gray	148,600	26,850	296,000	63,403	444,600	90,253
Shad	38,200	7,013	64,200	13,428	102,400	20,441
Sharks, grayfish	-	-	300	16	300	16
Spot	8,600	1,495	3,700	934	12,300	2,429
Striped bass	5,100	2,283	45,400	32,557	50,500	34,840
Sturgeon	200	31	-	-	200	31
White perch	17,000	3,539	21,000	6,907	38,000	10,446
Unclassified for food	400	71	1,300	185	1,700	256
Crabs, blue	296,800	112,716	878,200	322,560	1,175,000	435,276
Horseshoe crabs	-	-	400,000	4,000	400,000	4,000
Lobster, American	-	-	700	1,750	700	1,750
Oysters	1,218,200	1,400,372	127,500	196,190	1,345,700	1,596,562
Turtles, snapper	22,400	4,996	3,100	930	25,500	5,926
TOTAL	2,008,300	1,577,672	2,045,300	704,206	4,053,600	2,281,878

* Source: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service

Table 11 Ten most valuable commercial species landed in New Jersey from Delaware Bay, 1948 - 1977*

Species	Value	% of Total Landings	Pounds	% of Total Landings
Oyster	41,827,373	85.6	77,277,515	45.0
Blue crab	3,875,049	7.9	24,263,860	14.1
Menhaden	1,209,176	2.5	47,040,198	27.4
Hard clam	504,973	1.0	1,591,860	0.9
Striped bass	319,452	0.7	1,349,391	0.8
Eel	265,535	0.5	844,100	0.5
Shad	241,342	0.5	1,710,995	1.0
Weakfish	238,204	0.5	1,521,852	0.9
White perch	108,265	0.2	689,805	0.4
Carp	79,541	0.2	1,189,608	0.7
		99.6		91.7

* Source: Prepared from data supplied by the National Marine Fisheries Service, Department of Commerce

Table 12 U.S. Department of the Interior Designated Threatened/Endangered Species in the Lower Delaware River and Bay Region *

Species	Delaware	New Jersey	Pennsylvania
Blue whale, Balaenoptera musculus (E)	X	X	–
Bowhead whale, Balaena mysticetus (E)	X	X	–
Finback whale, Balaenoptera physalus (E)	X	X	–
Humpback whale, Megaptera novaeangliae (E)	X	X	–
Right whale, Eubalaena spp. (E)	X	X	–
Sei whale, Balaenoptera borealis (E)	X	X	–
Sperm whale, Physeter catodon (E)	X	X	–
Bald eagle, Haliaeetus leucocephalus (E)	X	X	X
American peregrine falcon, Falco peregrinus anatum (E)	X	X	X
Arctic peregrine falcon, Falco peregrinus tundrius (E)	X	X	X
Brown pelican, Pelecanus occidentalis (E)	X	X	–
Green sea turtle, Chelonia mydas (T)	X	X	–
Hawksbill sea turtle, Eretmochelys imbricata (E)	X	X	–
Atlantic Ridley sea turtle, Lepidochelys kempi (E)	X	X	–
Leatherback sea turtle, Dermochelys coriacea (E)	X	X	–
Loggerhead sea turtle, Caretta caretta (T)	X	X	–
Shortnose sturgeon, Acipenser brevirostrum (E)	X	X	X

(E) - Endangered
(T) - Threatened

* Source: Federal Register - January 17, 1979

TABLE 13 - Recent Catches of the Shortnose Sturgeon in the Delaware River

Year	Location	Gear Description	Season	Number (Size)
1972	Del. R. RM 102-124	16 ft. semi-ballon otter trawl-fished on bottom	Oct-Nov	1 (400 mm)
1975	Mercer Power Plant RM 131	Four intake screens	August	1 (616 mm)
1977	Trenton, N.J. RM 131	700 ft x 8 ft experimental gill nets, 2.0, 3.0, 4.0, 5.0 stretch measure	June	2 (769 mm) (640 mm)

*Source: The Delaware River Basin Anadromous Fishery Project

TABLE 14 - State of New Jersey, Department of Environmental Protection Designated Threatened/Endangered Species in the Lower Delaware River and Bay Region*

Shortnose sturgeon	Acipenser brevirostrum	(E)
Atlantic sturgeon	Acipenser oxyrhynchus	(T)
American shad	Alosa sapidissima	(T)
Southern gray treefrog	Hyla chrysoscelis	(E)
Eastern mud salamander	Pseudotriton montanus	(T)
Bog turtle	Clemmys muhlenbergi	(E)
Wood turtle	Clemmys insculpta	(T)
Indiana bat	Olyotis sodalis	(E)

Endangered (E) - A species whose prospects for survival in the state are in immediate danger due to one or many factors.

Threatened (T) - May become endangered if conditions surrounding the species begin to or continue to deteriorate.

*Source: New Jersey Department of Environmental Protection, Division of Fish Game and Shellfisheries.

TABLE 15 - Pennsylvania Fish Commission Designated Endangered/ Threatened Fishes, Amphibians and Reptiles in the Lower Delaware River Region*

Shortnose sturgeon	Acipenser brevirostrum	(E)
Threespine stickleback	Gasterosteous oculeatus	(E)
Eastern tiger salamander	Ambystoma tigrinum	(E)
New Jersey chorus frog	Pseudacris triseriata	(E)
Coastal plain leopard frog	Rana utricularia	(E)
Eastern mud turtle	Kinosternon subrubrum	(E)
Red-bellied turtle	Chrysemys rubriventris	(E)
Bog turtle	Clemmys muhlenbergi	(E)

(E) = Endangered

(T) = Threatened

*Source: Pennsylvania Fish Commission

Acipenser brevirostrum Lesueur, Shortnose sturgeon

ADULTS

D 33[17]–42,[1] A. 18–24;[9] C. 60; P. 30–31; V. 17–21;[18] dorsal shields 7[9]–13,[2] lateral shields 22[11]–34;[9] ventral shields 6[9]–11, gill rakers on first arch 22[2]–32.[9]

Proportions expressed as percent FL: Head length 18–22.[17] Proportions expressed as percent HL: Postorbital distance 51[2]–62, interorbital width 31–40;[10] snout length 37–50. Proportions expressed as percent snout length: Mouth width 44–77.[7] Proportions expressed as percent postorbital distance: Snout length 64–89.[10] Proportions expressed as percent interorbital width: Mouth width 63–90.[7] Proportions expressed as times in TL: Greatest depth 6.75, head 4.80. Proportions expressed as times in HL: Eye ca 14.[6]

Body elongate,[6] pentagonal in cross-section,[1] with 5 rows of enlarged shields.[2] Head large, convex, depressed between eyes,[18] snout, as compared to *A. oxyrhynchus* of similar size, shorter, more blunt, proportionately wider at base;[17] 4 barbels in ventral transverse row 1/3 to 1/2 distance from snout tip to upper lip.[7] Mouth width inside lips more than 3/5 width of bony orbit.[9] Eye small,[6] pupil rounded,[17] gill rakers rather long, triangular.[2] Shields regular, oblong, with sharp keel,[13] space separating dorsal shields as much as 1/2 length of shields themselves. Postdorsal and preanal shields single or paired. No enlarged bony plates between base of anal fin and lateral row of shields.[9] Upper lobe of caudal much longer than lower, dorsal fin just before caudal peduncle; anal fin under posterior portion of dorsal fin; pectoral fins just behind gill openings; ventral fins at beginning posterior 1/3 of body.[6]

Pigmentation: Brown above, tinged with copper on the sides (WLD); below lateral shields reddish mixed with violet, abdomen white.[18] Dorsal shields with whitish centers, lateral shields paler than surrounding skin; viscera blackish.[2] Iris with greenish tint (WLD).

Maximum size: 1353 mm TL;[7] 16.5 kg.[10]

DISTRIBUTION AND ECOLOGY

Range: St. John River, New Brunswick,[5] to St. Johns River, Florida;[2] rare and endangered.[3,10]

Area distribution: Possibly before Delaware[2] and Potomac Rivers,[5] also recorded from Virginia.[4]

Habitat and movements: Adults and juveniles—found most often in tidal rivers;[2] also recorded from open sea some distance from parent stream.[2] In St. John River, New Brunswick migrations to overwintering areas take place in September and October.[10] Overwintering occurs in estuarine lakes at depths exceeding 10 m,[9,10] and deeper regions of the lower estuary in salinities up to 20 ppt and temperatures of 4–8 C. During April move out of overwintering areas and concentrate in river channels. Around mid-June movement to summer feeding areas occurs.[10]

Larvae—on bottom for several days after hatching.[14]

SPAWNING

Location: Middle reaches of large tidal rivers.[1] In the St. John River, New Brunswick, spawning apparently occurs in the upper estuary adjacent to deep, turbulent sections of the river in extremely turbid water.[10]

Season: Females with mature eggs taken from the Hudson River in December (WLD), February[11] and April.[2] Spawning in the St. John River, New Brunswick, takes place between May 15 and June 15[10] and may continue until late August or early September.[9]

Time: During peak flood tide.[10]

Temperature: Average 10 C.[10]

Salinity: Fresh during spawning, possibly becoming brackish with changes in tidal cycles.[10]

Fecundity: 48,000–99,000.[10]

EGGS

Mature ovarian eggs—average diameter 3.0 mm;[10] dark brown in color.[2]

Fertilized eggs—demersal, extremely adhesive just after fertilization, after ca. 2 hours essentially nonadhesive.[2]

Pigmentation: Brown 1/2 circumference, grayish white other 1/2, eye visible 6 days after fertilization, light in color, 8–9 days after fertilization darker, plainly visible.[2]

Incubation: 4–6 days at unspecified temperature;[12] at 7.8–12.2 C, 13 days.[2]

YOLK-SAC LARVAE

Very dark in color,[14] otherwise no information.

LARVAE

No information.

JUVENILES

Specimen described 197 mm FL.[2]

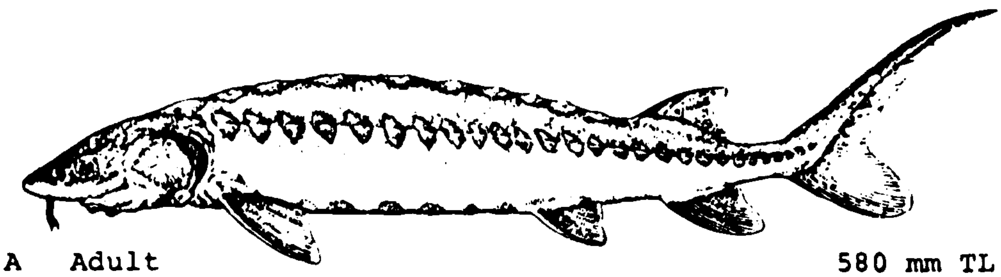

Fig. 3. *Acipenser brevirostrum*. Spawning female 580 mm TL. (*Vladykov, V. D., and J. R. Greeley, 1963: fig. 8*)

Head 28% of FL, postorbital distance 33% of HL.[2]

Snout longer than postorbital distance. Scutes on 5 main rows sharp, set closely together.[2]

AGE AND SIZE AT MATURITY

In St. John River, New Brunswick, 8.8±1.7 years, but females apparently do not spawn until 15.5±1.4 years, even though mature.[10] (Reports of 4–8 years in both sexes in the Hudson River[7] are based on incorrect aging methods, WLD.) Males may mature at 490 mm,[7] most above 533 mm are mature.[2] Smallest mature female 460 mm, smallest ripe female 700 mm TL.[10]

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UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
112 West Foster Avenue
State College, PA 16801

April 23, 1979

Colonel James G. Ton
Philadelphia Corps of Engineers
Custom House, 2nd & Chestnut Streets
Philadelphia, Pennsylvania 19106

Dear Colonel Ton:

In accordance with our FY79 Scope of Work agreement for the Delaware River Dredging Disposal Study, attached is our preliminary report "Fish and Wildlife Inventory of the Lower Delaware River and Bay Region."

Sincerely yours,

Michael T. Chezik

for Charles J. Kulp
Field Supervisor

Fish and Wildlife Inventory of the Lower Delaware River and Bay Region

Prepared For:

The Philadelphia District
Army Corps of Engineers
Delaware River Dredging
Disposal Study

Prepared By:

U.S. Fish and Wildlife Service

April 1979

TABLE OF CONTENTS

I. Introduction

This is a preliminary report on fish and wildlife resources of the lower Delaware River and Bay Region, provided in response to the Philadelphia District, Army Corps of Engineers, Delaware River Dredging Disposal Study. The purpose of the Congressionally authorized study is to develop a regional dredging spoil disposal plan for the tidal portions of the Delaware Bay, extending from Trenton, New Jersey, to the sea. The study was authorized by the United States Senate Committee on Public Works on September 20, 1974.

This report contains brief descriptions of finfish, benthic invertebrates, commercial and recreational fisheries, wetland wildlife and uses, and threatened/endangered species. It also contains a short discussion identifying areas sensitive to the disposal problem. The report addresses the river, bay, tidal segments of tributaries to each, and adjoining wetlands. Inland habitats are excluded from the discussion.

This report is submitted in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). It has been coordinated with the New Jersey Division of Fish, Game and Shellfisheries; the Delaware Division of Fish and Wildlife; the Pennsylvania Game and Fish Commissions; and the National Marine Fisheries Service.

II. Finfish

Delaware River

Homa (1978) reviewed benthic invertebrate and finfish literature for the Delaware River between Trenton (RM133) and the Chesapeake and Delaware Canal (RM53). His review emphasized shallow water areas while omitting deepwater and tributary habitats. Studies concerning the omitted habitats are briefly discussed below.

Miller et al (1974) conducted deepwater trawling at five stations in the Delaware River between Trenton and the Chesapeake and Delaware Canal during August to December 1973. The station names and locations are as follows: Trenton, RM 127-131; Bristol, RM-114-118; Bridesburg, RM 114-118; Philadelphia, RM 127-131; and Chester, RM 81-86. Eight-hundred and forty-three collections produced 15,043 fish of 21 species. Blueback herring made up 42 percent of the catch. Other species were white perch, 31 percent; spotted shiner, 8 percent; channel catfish, 9 percent; and white catfish, 5 percent (Table 1). In addition to these stations, the Schuylkill River, Neshaminy Creek and the main river adjacent to Wilmington were periodically trawled during this period. One hundred and forty-three collections produced 3,082 fish of 16 species. Blueback herring, spot, white perch and satinfin shiner made up 43, 38, 5 and 5 percent of the catch, respectively (Table 2).

In a separate study, Miller et al (1974) sampled 14 Delaware River tidal tributaries between Trenton and Wilmington from April to November 1973. A total of 14,410 fish of 31 species were collected by seine and trawl. Anadromous species were taken in all 14 tributaries. Blueback herring accounted for 91 percent of the anadromous catch followed by white perch (5 percent), alewife (4 percent) and American shad and striped bass (<1 percent). Blueback herring and alewife were generally more abundant in the tributaries which held the greatest variety and/or number of fish (Table 3).

Additional fish sampling was undertaken in the lower reaches of the Christina River and Brandywine Creek in spring and summer, 1978. Electrofishing by boat in the Christina River produced 12 species. The most abundant fish were carp, silvery minnow, menhaden, alewife and blueback herring. Similar sampling of the lower reach of Brandywine Creek resulted in 28 species collected. The most abundant fish in the Brandywine sampling were silvery minnow, carp, blueback herring, spottail shiner, white sucker, American Eel, alewife and white perch (Reichard, 1978).

Fish surveys by the Pennsylvania Fish Commission confirm that Darby Creek, Pennypack Creek and Neshaminy Creek support runs of blueback herring and alewife. American shad are not known to spawn in any of the Pennsylvania tributaries (Marshall, 1978)

The New Jersey Division of Fish, Game and Shellfisheries has surveyed several of the New Jersey tributaries in this reach. The results of their surveys were recently compiled and included in the Service's "Planning Aid Report: Existing Fish and Wildlife Resources Related to the Southern New Jersey Water Resources Study, Burlington, Camden and Gloucester Counties, New Jersey" (U.S. Department of the Interior, 1978).

Delaware Bay

Study of finfish in Delaware Bay began in the early 1950's. Since then, numerous studies have emphasized the variety of finfish present within the estuary. These include reports by Daiber (1954 a and b); Fitz (1956); June and Reintjes (1957); Harmic (1958); Bearden (1959); Reintjes and Roithmayr (1960); de Sylva and Kalber (1960); de Sylva, Kalber and Shuster (1962); Murawski (1966); Daiber and Abbe (1967); Daiber and Wockley (1968); Raney, Schuler and Denoncourt (1969); Smith (1969); Daiber and Smith (1969, 1970 and 1971 a and b); and Bason (1971). Many of these studies and others are briefly described in Polis (1972), Maurer and Wang (1973) and Maurer (1974).

Two hundred and eighteen species of finfish have been collected from the Delaware Bay region (Maurer and Wang, 1973) (Table 4). Nearly half of these are restricted to the higher salinity waters. About 40 species occur in marine and brackish water. Another 40 species occupy marine, brackish and freshwater. The remainder inhabit brackish and freshwater or freshwater.

Studies by de Sylva, Kalber and Shuster (1962) and Abbe (1967) indicate that the estuary is primarily important as a breeding ground for fish (over 60 species) and a nursery for juveniles.

Upper Estuary

Thomas (1971) collected 90 species of finfish from the Artificial Island area, including the river and four tidal creeks (Appoquinimink, Blackbird, Alloway and Hope Creeks) (Table 5).

Schuler (1971) collected 42,000 fish comprising 42 species in daylight seine samples. The 10 most abundant species, comprising 98 percent of the total, were Atlantic silverside, bay anchovy, blueback herring, mummichog, Atlantic menhaden, striped bass, white perch, alewife, rough silverside and tidewater silverside. Over 45,000 specimens were collected in daylight bottom hauls. Of these, 99 percent consisted of bay anchovy, weakfish, white perch, hogchoker, alewife, blueback herring, American eel, striped bass, bluefish and brown bullhead. According to Schuler, the Artificial Island area is an important nursery for weakfish, white perch striped bass and black drum, all sportfish species.

Lower Estuary

Daiber and Smith (1971 b) conducted the most recent comprehensive survey of finfish in the bay below Cohansey River during 1966 through 1970. A total of 136,093 fish of 69 species was caught. Weakfish (31 percent), hogchokers (23 percent), scup (13 percent), northern sea robin (4 percent) and windowpane (4 percent), comprised three-fourths of the catch (Table 6). Species diversity was less in the upper bay than in the lower bay and was greatest everywhere during the summer and fall.

Daiber (1954 b) gives the relative abundance of fish taken in commercial trawl samples during 1951 through 1954. The 10 most abundant fish were weakfish, spot, scup, hogchoker, summer flounder, northern sea robin, Atlantic croaker, spotted hake, butterfish and white perch. Five of Daiber's top 10, the summer flounder, Atlantic croaker, spotted hake, butterfish and white perch, all important recreational and commercial

species, do not occur in the top 10 of the 1971 study. The studies suggest that the smooth dogfish, roughtail ray, bullnose ray and striped sea robin are slowly becoming more abundant, while the clearnose skate, silver hake, summer flounder and northern puffer are, in general, declining in abundance.

Tidal Tributaries

Although the New Jersey Division of Fish, Game and Shellfisheries has surveyed many of the streams draining into Delaware Bay, most were surveyed in the upper non-tidal reaches. Fishery data for the tidal segments are scarce. The Maurice River is an exception. Himchak (1978) and McClain (1978) sampled ichthyoplankton and finfish in the lower Maurice from October 1975 to September 1976. Planktonic forms of 23 fish species were collected. Bay anchovy, naked goby, Atlantic croaker, spot, menhaden and American eel made up 98 percent of the collection. Additional species were taken as either adults or juveniles.

Many streams in New Jersey support spawning runs of alewife or blueback herring (Table 7). None are known to support spawning runs of American shad.

Martin (1974) sampled 13 Delaware tidal streams draining into Delaware Bay. These included Reybold Creek, Silver Run, Appoquinimink River, Blackbird Creek, Smyrna River, Leipsic River, Simons Creek, Mahon River, Little River, St. Jones River, Murderkill River, Mispillion River and Broad Creek. Indian River, Rehoboth and Little Assawoman Bays were also sampled. The results show tidal streams are important nursery, forage and spawning habitats for a variety of fishes. Species commonly present in adult and/or juvenile stages are white perch, weakfish, spot, menhaden, American eel, blueback herring, alewife, striped bass, bay anchovy, naked goby, white mullet, winter flounder and silverside shiner. The less saline segments usually contain white catfish, channel catfish, carp and yellow perch.

III. Benthos

The first published account of benthic assemblages in Delaware Bay was a paper on the associated oyster fauna (Maurer and Watling, 1973). A series of papers dealing with the distribution and ecology of specific taxa was also completed: Amphipoda (Watling and Maurer, 1972a); Hydroids (Watling and Maurer, 1972b); Pelecypoda (Maurer, Watling and Aprill, 1974); Isopoda (Watling, Lindsay and Maurer, 1974); and Gastropoda (Leathem and Maurer, 1975). Additionally, Kenner, Maurer and Leathem (1975) described animal-sediment associations of dominant benthic species.

Watling, Maurer and Wethe (1976) undertook the first comprehensive sampling of benthic invertebrates in Delaware Bay. During July and August 1972 and June and July 1973, 207 samples were taken along 26 transects between Cape Henlopen and Stone Creek. One hundred and nine species were obtained during 1972 and 125 during 1973 (Table 8). There were no significant changes in relative abundance of phyla from one year to the next. The average numer of individuals per sample for both 1972 and 1973 was 20 (200 individuals/m^2). At only ten stations of the 207 sampled were there more than 1,000 individuals/m^2. The authors suggested the low densities were due to a lack of attached benthic macroscopic algae or vascular plants in the bay, which in turn, was most likely related to the highly turbid conditions in the bay. The absence of macroscopic benthic algae deprives the benthic community of a major source of organic material that would be used by deposit feeders. The most widespread species were *Tellina agilis*, *Heteromastus filiformis*, *Glycera dibranchiata*, *Nephtys picta*, *Mulinia lateralis*, *Protohaustorius wigleyi*, *Gemma gemma* and *Nucula proxima*.

Benthic invertebrate studies for the Delaware River are described by Homa (1978). We were unable to locate any relevant information not covered in Homa's report.

IV. Commercial Fisheries

The National Marine Fisheries Service, Department of Commerce records commercial finfish and shellfish catches within the Delaware River and Bay. The mean values for catches recorded from 1960 through 1977 and from 1973 through 1977 are approximately $1.7 and $3.1 million respectively (Table 9).

Species composition, poundage and value of 1977 commercial finfish and shellfish catches for Delaware Bay and River, are given in Table 10. Oysters comprised 70.0 percent of the total harvest value. Blue crabs were a distant second at 19.1 percent followed by sea trout 4.0 percent, eel 2.5 percent, and striped bass 1.5 percent. Together these five species made up 97.1 percent of the total 1977 harvest value.

Analysis of catches landed from the New Jersey side of Delaware Bay, 1948 through 1975, reveals that oysters comprised 85.6 percent of the harvest value (Table 11). Other species comprising the top 5 were blue crab (7.9 percent), menhaden (2.5 percent), hard clam (1.0 percent) and striped bass (0.7 percent). Together these 5 species comprised 97.7 percent of the 1948-1975 harvest value (New Jersey side only).

The paramount importance of the oyster to commercial fisheries in Delaware Bay, both in the past and present, is evident from the catch data. A description of the oyster industry is found in the Service's planning aid report: "The Effect of Salinity Change on the American Oyster in Delaware Bay (1979)."

Second in importance is the blue crab. It occurs from the vicinity of Philadelphia to the mouth of the bay, and is commonly found in tidal tributaries. Harvesting is by potting and dredging. Potting occurs during non-winter months, while dredging is a winter time activity restricted to deepwater sediments. Approximately 3,000 acres of bay bottom in New Jersey are leased for dredging crabs. In Delaware leasing is not a requirement, but fisherman may not dredge in leased oyster grounds. Most dredging occurs in the lower bay.

In the past and occassionally in recent years (e.g., 1974) the Atlantic menhaden has been an important species. According to Homa (1978) menhaden probably spawn in the deeper areas of Delaware Bay. They use the shore zones and tidal creeks of the lower estuary as nursery areas. Menhaden are processed for fish meal and oil.

Besides being an important sportfish, the weakfish is also a valuable commercial species. Weakfish enter the bay in early May. Spawning occurs from late May to early August along the shoals and in the Delaware River. Juveniles are found in upper tidal tributaries such as Silver Run, Appoquinimink, Blackbird, Smyrna and Mahon Creeks in Delaware (Martin 1974) and Alloway, Hope (Smith 1971); Dividing and Oranoaken Creeks (McClain 1978), New Jersey. In late September, the large weakfish begin leaving the bay, followed by the smaller fish and eventually the young of year (Martin 1974).

The striped bass is another fish with both commercial and recreational importance. Formerly a common migrant in the Delaware River, it now spawns primarily in the vicinity of Artificial Island and in the Chesapeake and Delaware Canal. The juveniles inhabit tidal streams until their third year when they travel to the ocean (Martin 1974).

The American eel is a catadromous species. It spawns in the Atlantic Ocean, but migrates to brackish or freshwater to spend most of its juvenile and adult life. The eel prefers muddy bottom streams and is present throughout the lower Delaware drainage.

The hard clam is widely distributed throughout lower Delaware Bay, but is not present in commercial densities. A 1972 survey of the west side of the bay disclosed two areas with potential as commercial clam beds: Joe Flogger and Old Bare Shoals (Keck, Watling and Maurer, 1972).

V. Recreational Fisheries

In 1961, the Fish and Wildlife Service estimated that approximately 130,000 saltwater sportfishermen annually devote 900,000 man-days to fishing within Delaware Bay. Most of these were finfishermen. However, an uncounted number also engaged in clamming and crabbing. The six finfish species that accounted for the largest annual harvests by sportfishermen were bluefish, scup, weakfish, summer flounder, sea bass and croaker (U.S. Fish and Wildlife Service, 1962).

Martin (1973) reported 330,935 man-days of sportfishing from boats in western Delaware Bay in 1973, with an average number of 2.8 anglers per private boat, 8.0 per charter boat and 38.5 per head boat. Weakfish comprised 90 percent of the 1971-73 sport catch.

Using Martin's data, Smith (1975) estimated that boat fishing contributes $4.5 million to the west bay economy. He also determined from use surveys that boat fishing was concentrated in the lower bay, especially in areas associated with the navigation channel running through the Ship Anchorage or lightering area; that weakfish, summer flounder, black sea bass, and black drum were the primary species sought by Delaware head boats; and that the mean number of sportfishing boats in western Delaware Bay on weekdays and Sundays was 180.4 ± 6.9 and 447.6 ± 162.3, respectively.

The most recent (1976) survey of sportfishing in Delaware by Miller (1977) showed no appreciable change in sportfishing effort by boaters since 1973. However, shore fishing effort had appreciably increased from 128,512 man-days in 1973 to 225,129 man-days in 1976. The author cautioned that any real differences in fishing pressure could have been masked by differences in survey compilation techniques. Future studies on sportfishing in Delaware, occuring at approximately three year intervals, should avoid this problem.

For eastern Delaware Bay (Salem, Cumberland and Cape May Counties) an estimated 300,000 to 650,000 man-days of sportfishing effort are expended annually from April through November. Boat fisherman account for 75 to 80 percent of the effort and about 95 percent of the catch. At least 85 percent of the fish landed by boat fisherman are weakfish. Boat fisherman also catch summer flounder, bluefish, spot, striped bass, black sea bass, white perch, kingfish, winter flounder, black drum, shark, carp, catfishes, and American eel. White perch make up from a third to a half of the catch of shore fisherman, with summer flounder, bluefish, striped bass, spot, winter flounder, catfishes, carp and American eel making up the remainder (U.S. Fish and Wildlife Service, 1975).

The Pennsylvania Fish Commission (1975) estimates that the Delaware River in Philadelphia and Delaware Counties provides approximately 56,000 man-days of fishing annually for alewife, blueback herring, shad, bullhead, sucker, sunfishes, carp and eel. The Schuylkill River in Philadelphia County provides approximately 43,000 man-days for identical species, including muskellunge.

Fisherman use estimates for the New Jersey side of the river are not available. However, we would expect an amount similar to that occurring from Pennsylvania.

Fisherman use data for the tidal tributaries is generally lacking. Martin (1974) provides guidance to fishermen on where and how to catch fish in the Delaware tributaries, but does not indicate a current level of use. Figley (1978) conducted a year-long use survey of the Maurice River estuary between October 1975 and September 1976. Part of the survey included a section of Delaware Bay (Maurice River Cove). As might be expected, recreational use peaked during summer (August) and reached a low point in winter (January). Bank and boat fishing amounted to 15,986 and 15,179 man-days respectively.

Based on the survey information available, fisherman use of the lower Delaware River, Delaware Bay and tidal tributaries is at least 1.2 million man-days per year. We estimate that 90 percent of the use is by saltwater anglers and 10 percent is by warmwater fishermen. Since saltwater fishermen spend an average $16.65 per man-day of angling (U.S. Department of the Interior, 1977), saltwater fishermen annually contribute an estimated $18.0 million to the regional economy. The average man-day expenditure by warmwater fishermen is $8.48. Therefore, the annual contribution from warmwater fishermen is $1.0 million. We regard these as conservative estimates. Additional fisherman use surveys, particularily on the tidal tributaries, might increase these estimates.

VI. Wetland Wildlife and Uses

A 1973 survey by the Academy of Natural Sciences disclosed that the Delaware River, estuary and tributaries between Trenton, New Jersey and Cape May - Henlopen drain approximately 176,000 acres of freshwater and brackish water wetlands (1). Approximately 10,000 acres are of the freshwater type and occur between Trenton, New Jersey and Wilmington, Delaware. The remaining 166,000 acres are mainly brackish and occur between Wilmington and Cape May - Henlopen. The more common freshwater wetland plants are *Scirpus americanus*, *S. olneyi*, *Polygonum punctatum*, various species of *Eleocharis* and *Sagittaria*, *Zizania aquatica*, *Peltandra virginica*, *Nuphar advena* and species of *Pontederia* and *Lythrum*. Where channelization, ditching or filling has occurred, *Phragmites communis* is often dominant. Brackish water vegetation is characterized by *Spartina alterniflora*, *S. patens* and *Distichlis spicata* (The Academy of Natural Sciences, 1973).

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(1) A 1961 survey by the Service disclosed approximately 206,000 acres of wetlands within the Coastal Plain physiographic section. The 1961 survey encompassed a slightly larger area than did the Academy of Natural Sciences survey, and this largely accounts for the disparity between the two survey estimates.

The freshwater and brackish water wetlands and adjoining upland provide essential habitat for a variety of vertebrates collectively identified as wetland wildlife. As least 144 species of birds, including 30 species of waterfowl, 39 species of shore and wading birds, 16 birds of prey and 59 others, occur in or near wetlands. Added to these are 22 amphibians, 22 reptiles and 17 mammals, all occurring in or near wetlands.

An estimated 300,000 ducks and geese overwinter in these wetlands. About 225,000 (76 percent) inhabit the Delaware marshes. Of these, 150,000 are Canada geese (Graham, R. 1979). Approximately 55,000 waterfowl (18 percent) overwinter in New Jersey (U.S. Fish and Wildlife Service, 1975). Wetlands in Pennsylvania, principally Tinicum Marsh, overwinter the remaining 20,000 (7 percent). Over 75 percent of the Pennsylvania waterfowl are diving ducks (W. Drasher 1979). Although most of the 300,000 waterfowl leave the basin wetlands after winter, a substantial number, mainly puddle ducks, remain to breed.

A 1977-78 survey of waterfowl hunting in the Delaware portion of the basin disclosed that 22,200 hunters expended 183,600 man-days hunting ducks, geese and rails (Florio 1979). A similar survey of the New Jersey portion in 1974-75 disclosed 17,800 hunters and 115,400 man-days (New Jersey Division of Fish, Game and Shellfisheries, undated). Such surveys have not been conducted in Pennsylvania. However, the Pennsylvania Game Commission indicates that hunting pressure there is substantially less than in New Jersey (Drasher 1979). Based on the two surveys and a conservative guess in Pennsylvania, we estimate that the basin below Trenton annually provides 43,000 hunters 320,000 man-days of waterfowl hunting. Since migratory bird hunters spend an average $10.82 per man-day of hunting (U.S. Department of Interior, 1977), waterfowl hunters annually contribute an estimated $3.5 million to the regional economy.

The basin wetlands also support a valuable fur industry. Muskrat and raccoon are most important. Other less important species are red and gray fox, opposum, mink, weasel and skunk.

A 1977 survey of trapping in New Jersey revealed that 1,369 trapping licenses were sold in counties comprising the New Jersey side of the basin (1). Trappers expended approximately 77,000 man-days trapping within these counties. The harvest was valued at $1.4 million (New Jersey Division of Fish, Game and Shellfisheries, 1977). In Delaware, a 1977-78 survey revealed that 2,000 trapper/hunters expended 41,000 man-days trapping muskrat and trapping/hunting raccoon. The total furbearer harvest from the Delaware side of the basin was valued at $3.5 million. Surveys of furbearer harvests in Pennsylvania have not been undertaken. Because Pennsylvania has the least amount of wetland and is

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(1) Burlington, Camden, Cape May, Cumberland, Gloucester and Salem.

the most developed of the three states, it is reasonable to expect that it produces the lowest furbearer harvest. Considering the two surveys and a conservative guess of the Pennsylvania harvest, we estimate the annual value of the furbearer resource below Trenton at $2.1 million.

According to the "1975 National Survey of Hunting, Fishing and Wildlife - Associated Recreation," 27 percent of the U.S. population 9 years or older in 1975 participated in wildlife observation and 8 percent engaged in wildlife photography. Wildlife observation amounted to 1.6 billion man-days or 33 man-days per wildlife observer. Wildlife photography totaled 156.7 million man-days or 10 man-days per wildlife photographer (U.S. Department of Interior, 1977).

The Delaware River Basin Commission estimates that 1.8 million people reside in the Coastal Plain section of the basin (Kausch 1979). According to the national average, 86 percent or approximately 1.5 million of these people are 9 years of age or older. Using the referenced population percentages for wildlife observer (27 percent) and wildlife photographer (8 percent), we estimate the numbers of wildlife observers and wildlife photographers in the Coastal Plain are 405,000 and 120,000 respectively. The estimated numbers of man-days expended on wildlife observation and wildlife photography are 13.4 million and 1.2 million, respectively. The 1975 national survey did not indicate average expenditures for wildlife observers or wildlife photographers. However, if each wildlife observer and photographer spent only $10 annually, the contribution to the economy would be $5.3 million. The actual value is probably higher.

VII. Threatened/Endangered Species

The lower Delaware River and Bay Region is within the historic range of 17 federally designed threatened or endangered species (Table 12): seven whales, five marine turtles, four birds and one fish. The whales and turtles are primarily oceanic, but occassionally venture into Delaware Bay. Three of the birds are raptorial and migrate through the area. The other bird, the brown pelican, is a rare visitor. The shortnose sturgeon inhabits the river and possibly the upper bay.

Information on the specific distribution of these species and their life requirements is often fragmentary. This is particularily true of the shortnose sturgeon, a bottom dwelling fish potentially most likely to be affected by dredging/filling. The little information known about the shortnose is mainly the result of research conducted from the St. John River, New Brunswick. This work and other relevant studies were recently summarized in the Fish and Wildlife Service publication "Development of Fishes of the Mid-Atlantic Bight" (1978). A copy of the summary is included at the end of this report. Also included is a summary of recent shortnose collections from the Delaware River made by biologists from the Delaware River Basin Anadromous Fishery Project, Rosemont, New Jersey (Table 13).

No federally designated or proposed threatened or endangered plants occur within the project area. However, four indigenous plants are being considered for addition to the threatened species list (Federal Register, Volume 40, No. 127, July 1, 1975). These are Nuttall's micranthemum, purple fringeless orchis, Long's bulrush and Pine Barren's reedgrass. It should be emphasized that none of these species have been officially proposed for addition to the threatened list. Therefore, they are not currently subject to the protection afforded by the Endangered Species Act, as amended in 1978. We mention them simply because they could be officially proposed during project planning, which would then make them subject to the Act.

Nuttall's micranthemum, Micranthemum micranthemoides, a member of the figwort family, is normally found on tidal mudflats. Collectors have taken specimens adjacent to the Delaware River in Bucks and Philadelphia Counties, Pennsylvania and Camden and Burlington Counties, New Jersey. It has also been recorded from similar habitat in Delaware.

Purple fringeless orchis, Habenaria peramoena, a member of the orchid family, occurs in meadows, bogs, alluvial thickets and low woods. It may also be found along saltmarsh margins. Collectors have taken specimens in Camden and Cape May Counties, New Jersey and Chester County, Pennsylvania. It has also been taken in Delaware.

Long's bulrush, Scirpus longii, occurs in freshwater marshes and swamps in Burlington County, New Jersey.

Pine Barren's reedgrass, Calamovilfa brevipilis var. brevipilis, occurs in swamps and bogs of Burlington and Cape May Counties, New Jersey.

Species designated as threatened or endangered by the individual basin states are shown in Tables 14 and 15. The Delaware list (not shown) is the same as the Federal list. Pennsylvania currently does not have a list of threatened or endangered birds and mammals.

This section does not fulfill requirements in accordance with Section 7 of the Endangered Species Act, as amended in 1978. For specific guidance on formal consultation procedures, we recommend the Corps review the Federal Register, Volume 43, No. 2, dated January 4, 1978.

VIII. Areas Sensitive To The Disposal Problem

Our current knowledge of fish and wildlife resources in the lower Delaware River Basin is largely the result of a long succession of proposals to modify the environment. This is not an unusual situation and commonly occurs elsewhere in the United States. Unfortunately, the value of sporadic biological study is quite limited. This is particularily true

for the study of estuarine biota, which depend upon or are subject to a myriad of natural or artificial regulations, including temperature, flow, salinity, water quality, substrate, food, season, cover, etc. Any one of these factors and certainly many more individually or synergistically determine species presence, abundance, activity and human use. Despite such variables, certain generalizations are valid and have long been noted in our correspondence to the Army Corps of Engineers.

Wetland plants, including emergent, submergent and floating leaf hydrophytes, nearly always provide valuable habitat for fish and wildlife. They provide food and cover for many species and also serve as sites for reproduction and early growth. The study area still has a significant wetland acreage. Unfortunately over 90 percent of the wetlands occur south of Wilmington. Therefore, remaining wetlands north of this city take on added importance. The Service is committed to protection of all wetlands and generally seeks opportunities to create additional wetland areas. We particularily would like to see new wetlands created between Trenton and Philadelphia.

Non-vegetated shallow water areas also provide food, cover and nursery and spawning habitat. Although it is not well-documented, the current biological opinion is that non-vegetated shallows can be made more productive by establishing wetland plants. This generalization is not necessarily true for all shallows, or for that matter, all species. For example, smallmouth bass seek out gravel bottom shallows for spawning.

The Service is generally protective of shallow water areas, particularily where water quality is good or is likely to improve. We occassionally approve conversion of deepwater areas into shallow water habitats, but prefer that the shallows, once created, also be planted with wetland vegetation. These proposals must be reviewed on a case by case basis.

Vegetated wetlands and shallow water areas, are not the only sites sensitive to the disposal problem. Other sensitive areas include oyster seed beds and leased areas, blue crab dredging areas, hard clam beds, spawning and nursery grounds for important commercial/recreational finfish and islands. Islands serve as natural refuges for migrating waterfowl and other bird life and are sometimes heavily used for nesting (e.g., Pea Patch Island).

In general, the body of biological information available suggests that developed areas are least valuable for fish and wildlife. A good example of this is the Philadelphia - Wilmington corridor which has a limited fish population for about half the year. The problem is due mainly to poor water quality. Even if water quality significantly improved, it is likely that fish productivity there would still be lower than in other less developed areas where habitat is more diverse. Improved water quality would, however, significantly benefit migratory species (e.g., American shad).

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X. Tables and Supplement

Table 1 SUMMARY OF TOTAL CATCH BY NUMBER, RANK, AND PERCENT FOR FIVE TIDAL RIVER TRAWLING STATIONS, DELAWARE RIVER - 1973

	Rank	Trenton	Bristol	Bridesburg	Philadelphia	Chester	Total	% Total Catch
No. Species		13	16	13	10	14	21	
No. Specimens		3899	7920	2217	365	642	15043	
No. Collections		156	159	180	177	171	843	
Blueback Herring	1	678	3670	1425	158	427	6358	42.3
White Perch	2	1533	2578	367	43	71	4592	30.5
Spottail Shiner	3	1032	132	27	4	1	1196	8.0
Channel Catfish	4	53	862	40	0	0	955	6.3
White Catfish	5	420	275	82	1	2	780	5.2
Alewife	6	66	241	85	57	2	451	3.0
Silvery Minnow	7	19	34	6	85	110	254	1.9
American Eel	8	8	14	176	8	5	211	1.4
Brown Bullhead	9	73	13	1	1	12	100	0.7
Bluegill	10	0	74	0	0	4	78	0.5
Tessellated Darter	11	11	10	1	0	0	22	0.1
American Shad	12	4	9	0	2	0	15	*
Striped Bass	13	0	1	3	0	4	8	*
Mummichog	14	0	0	0	6	1	7	*
White Sucker	15	0	5	0	0	0	5	*
Gizzard Shad	16	1	0	2	0	1	4	*
Banded Killifish	17	0	0	2	0	1	3	*
Largemouth Bass	18	0	1	0	0	0	1	*
Fallfish	18	1	0	0	0	0	1	*
Carp	18	0	0	0	0	1	1	*
Golden Shiner	18	0	1	0	0	0	1	*

* - Less than one-tenth percent

Table 2 SUMMARY OF TOTAL CATCH BY NUMBER, RANK, AND PERCENT AT THREE ADDITIONAL TRAWLING STATIONS, TIDAL DELAWARE RIVER - 1973

Species	Rank	Wilmington	Neshaminy Creek	Schuylkill River	Total	% Total Catch
No. Species		12	5	4	16	
No. Specimens		2846	83	153	3082	
No. Collections		30	5	26	106	
Blueback Herring	1	1316	72	0	1388	43.4
Spot	2	1169	0	0	1169	37.9
White Perch	3	155	2	0	157	5.1
Satinfin Shiner	4	0	0	150	150	4.9
Spottail Shiner	5	85	1	0	86	2.8
American Eel	6	65	0	0	65	2.1
Alewife	7	39	0	0	39	1.3
Bluegill	8	0	7	1	8	0.3
Striped Bass	9	7	0	0	7	0.2
Brown Bullhead	10	5	0	1	6	0.2
Yellow Perch	11	2	0	0	2	*
American Shad	12	0	1	0	1	*
Black Crappie	12	1	0	0	1	*
Carp	12	1	0	0	1	*
Mummichog	12	0	0	1	1	*
Pumpkinseed	12	1	0	0	1	*

*/ Less than one-tenth percent

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Table 3 CATCH OF INDIVIDUAL ANADROMOUS SPECIES, NUMBER OF OTHER FISH, AND SPECIES DIVERSITY FROM 14 TIDAL DELAWARE RIVER TRIBUTARIES - 1973

Tributary Name	River Mile	American Shad	Blueback Herring	Alewife	Striped Bass	White Perch	Other Species	Variety Species	Total All Fish
1. Christina River	71	0	297	26	0	15	264	15	602
2. Brandywine Creek	71	0	1	0	0	0	2	3	3
3. Oldmans Creek	77	0	1200	4	0	2	244	11	1450
4. Raccoon Creek	81	0	778	4	0	2	591	15	1375
5. Darby Creek	85	0	3	0	0	0	1317	3	1320
6. Mantua Creek	90	0	70	1	0	2	379	9	452
7. Woodbury Creek	92	0	1968	191	0	65	1385	13	3609
8. Big Timber Creek	95	0	567	0	0	2	550	11	1119
9. Cooper River	102	0	44	0	1	167	458	11	670
10. Pennsauken Creek	105	0	444	23	0	0	187	8	654
11. Pennypack Creek	110	4	1	0	0	0	79	8	84
12. Rancocas Creek	111	1	835	0	0	87	758	16	1681
13. Neshaminy Creek	116	3	1050	49	0	93	170	14	1365
14. Crosswicks Creek	128	1	18	0	0	3	4	5	26
Total		9	7276	298	1	438	6388	31	14410

TABLE 4 List of fishes collected from the Delaware Bay Region. Type of species: M = Marine; B = Brackish (Sal. 1-10 ppt); F = Fresh. Primary activity in area: M = Migrant; SP = Spawning in Area; SF = Summer Feeding; WF = Winter Feeding; N = Nursery; R = Resident Species; ST = Stray

Species	Type of Species	Primary Activity in Area
PETROMYZONITIDAE - LAMPREYS		
Petromyzon marinus - Sea lamprey	M, B, F	M
CARCHARIIDAE - SANDSHARKS		
Carcharias taurus - Sandshark	M, B	SF
LAMNIDAE - MACKERAL SHARKS		
Alopias vulpinus - Thresher shark	M	SF
ODONTOSPIDIDAE - SAND TIGERS		
Odontaspis taurus - Sand Tigers	M	M
CARCHARHINIDAE - REQUIEM SHARKS		
Carcharhinus milberti - Sandbar shark	M	SF
C. obscurus - Dusky shark	M	ST
Mustelus canis - Smooth dogfish (Lewes)	M	SF
Prionace glauca - Blue shark	M	SF
Scoliodon terra and novae - Atlantic sharpnose shark	M	ST
SPHYRNIDAE - HAMMERHEAD SHARKS		

TABLE 4

Species	Type of Species	Primary Activity in Area
Sphyrna tiburo - Bonnethead	M	SF
S. zygaena - Smooth hammerhead	M	
TORPEDINIDAE - ELECTRIC RAYS		
Torpedo nobiliana - Atlantic torpedo	M	ST
SCYLIORHINIDAE - CAT SHARKS		
Scyliorhinus retifer - Chain dogfish	M	M
SQUALIDAE - DOGFISH SHARKS		
Squalus acanthias - Spiny dogfish	M	WF
SQUATINIDAE - ANGEL SHARKS		
Squatina dumerili - Atlantic angel shark	M	SF
RAJIDAE - SKATES		
Raja eglanteria - Clearnose skate	M	SF
R. erinacea - Little skate	M	WF
R. garmani - Rosette skate	M	ST
R. laevis - Barndoor skate	M	
R. ocellata - Winter skate	M	WF
R. radiata - Thorny skate	M	
DASYATIDAE - STINGRAYS		

TABLE 4 (cont.)

Species	Type of Species	Primary Activity in Area
Dasyatis centroura - Roughtail stingray	M	SF
D. sabina - Atlantic stingray (off Bowers)	M	
D. sayi - Bluntnose stingray	M	SF
Gymnura altavela - Spiny butterfly ray	M	
G. micrura - Smooth butterfly ray	M	
Urolophus jamaicensis - Yellow stingray	M	ST
MYLIOBATIDAE - EAGLE RAYS		
Myliobatis freminvillei - Bullnose ray	M	SF
Rhinoptera bonasus - Cownose ray	M	ST
CHIMAERIDAE - CHIMAERA		
Hydrolagus colliei - Ratfish	M	ST
ACIPENSERIDAE - STURGEONS		
Acipenser oxyrhyncus - Atlantic sturgeon	M, B, F	M
ELOPIDAE - TARPONS		
Megalops atlantica - tarpon	M	ST
ANGUILLIDAE - FRESHWATER EELS		
Anguilla rostrata - American eel	M, B, F	M, SF, N, R

TABLE (cont.)

Species	Type of Species	Primary Activity in Area
CONGRIDAE - CONGER EELS		
Conger oceanicus - Conger eel	M	
CLUPEIDAE - HERRINGS		
Alosa aestivalis - Blueback herring	M, B, F	SP, N
A. mediocris - Hickory shad	M, B, F	M (adults), SF (young)
A. pseudoharengus - Alewife	M, B, F	SP, N
A. sapidissima - American shad	M, B, F	M
Brevoortia tyrannus - Atlantic menhaden	M, B, F	N, SF
Clupea harengus harengus - Atlantic herring	M, B	
Dorosoma cepedianum - Gizzard shad	F, B	R, SP
Etrumeus teres - Atlantic round herring	M, B?	
Opisthonema oglinum - Atlantic thread herring	M	
ENGRAULIDAE - ANCHOVIES		
Anchoa hepsetus - Striped anchovy	M, B	ST
A. mitchilli - Bay anchovy	M, B, F	SP?, N, SF
Engraulis eurystole - Silver anchovy	M, B	
UMBRIDAE - MUDMINNOWS		
Umbra pygmaea - Eastern mudminnow	F	ST

TA 4

Species	Type of Species	Primary Activity in Area
ESOCIDAE - PIKES		
Esox americanus - Redfin pickerel	F, B	R, SP
E. niger - Chain pickerel	F, B	R, SP
SYNODONTIDAE - LIZARD FISHES		
Synodus foetens - Inshore lizard fish	M	
CYPRINIDAE - MINNOWS AND CARPS		
Carassius auratus - Goldfish	F, B	R, SP?
Cyprinus carpio - Carp	F, B	R, SP
Exoglossum maxillingua - Cutlips minnow	F, B	R, SP
Hybognathus nuchalis - Silvery minnow	F, B	R, SP
Notemigonus crysoleucas - Golden shiner	F, B	R, SP
Notropis analostanus - Satinfin shiner	F	R, SP (upper crk lak
N. bifrenatus - Bridle shiner	M, B	WF
N. hudsonius - Spottail shiner	F, B	R, SP
Rhinichthys atratulus - Blacknose dace	F	ST
CATOSTOMIDAE		
Carpoides cyprinus - Quillback (C & D Canal)	F	ST
Catostomus commersoni - White sucker (upper marsh crks)	F	R, SP (upper creeks)

TABLE (cont.)

Species	Type of Species	Primary Activity in Area
Erimyzon oblongus - Creek chubsucker (upper marsh crks)	F	R, SP (upper creeks)
ICTALURIDAE - FRESHWATER CATFISHES		
Ictalurus catus - White catfish	F, B	R, SP
I. nebulosus - Brown bullhead	F, B	R, SP
I. punctatus - Channel catfish	F, B	R, SP
Noturus gyrinus - Tadpole madtom (upper Blackbird Crk)	F	R, SP (upper creeks)
BATRACHOIDIDAE - TOADFISHES		
Opsanus tau - Oyster toadfish	M, B	SF?
LOPHIIDAE - GOOSEFISHES		
Lophius americanus - Goosefish (dead on beach at Bayview)	M, B?	ST
GADIDAE - CODFISHES		
Enchelyopus cimbrius - Fourbeard rockling	M	ST
Gadus morhua - Atlantic cod	M	WF
Melanogrammus aeglefinus - haddock	M	WF
Merluccius bilinearis - Silver hake	M, B	
Pollachius virens - Pollock	M	
Urophycis chuss - Squirrel hake	M, B	
U. regius - Spotted hake	M, B	SF
U. tenuis - White hake	M, B	

TABLE 4(cont.)

Species	Type of Species	Primary Activity in Area
EXOCOETIDAE - FLYINGFISHES AND HALFBEAKS		
Cypselurus heterurus - Atlantic flyingfish	M	ST
Hyporhamphus unifasciatus - Halfbeak (Lewes)	M, B	
BELONIDAE - NEEDLEFISHES		
Ablennes hians - Flat needlefish	M	
Hemiramphidae - Halfbeaks		
Hyporhamphus unifasciatus - Halfbeak	M	
Strongylura marina - Atlantic needlefish	M, B, F	N, SF
S. raphidoma - Houndfish	M	
CYPRINODONTIDAE - KILLIFISHES		
Cyprinodon variegatus - Sheepshead minnow	M, B, F	SF
Fundulus diaphanus - Banded killifish	F, B, M	R, SP
F. heteroclitus - Mummichog	B, F, M	R, SP
F. luciae - Spotfin killifish		
F. majalis - Striped killifish	M, B	SF
Lucania parva - Rainwater killifish	M, B	
POECILIIDAE - LIVEBEARERS		
Gambusia affinis - Mosquitofish	M, B, F	R, SP

TABLE 4 (Cont.)

Species	Type of Species	Primary Activity in Area
ATHERINIDAE - SILVERSIDES		
Membras martinica - Rough silverside	M, B, F	SF, SP?
Menidia beryllina - Tidewater silverside	B, F, M	R, SP
M. menidia - Atlantic silverside	M, B, F	R, SP
POLYMIXIIDAE - BEARDFISHES		
Polymixis lowei - Beardfish	M	ST
GASTEROSTEIDAE - STICKLEBACKS		
Apeltes quadracus - Fourspine stickleback	M, B, F	WF
Gasterosteus aculeatus - Threespine stickleback	M, B, F	WF
SYNGNATHIDAE - PIPEFISHES AND SEAHORSES		
Hippocampus erectus - Lined seahorse	M, B	ST
H. hudsonius - Lined seahorse	M, B	
H. obtusus - Offshore seahorse	M	ST
Syngnathus fuscus - Northern pipefish	M, B, F	N, SF
S. pelagicus - Sargassum pipefish	M	
CENTROPONIDAE - SNOOKS		
Centropomus undecimalis	M	
FISTULARIIDAE - CORNETFISHES		
Fistularia tabacaria - Cornetfish	M, B?	SF

TABL_ 4(cont.)

Species	Type of Species	Primary Activity in Area
CENTRISCIDAE - SNIPEFISHES		
Macrorhamphosus scolopax - Longspine snipefish	M	SF
SEPRANIDAE - SEA BASSES		
Centropristes striatus - Black sea bass	M, B?	SF
Epinephelus niveatus - Snowy grouper	M	ST
CARANGIDAE - JACKS AND POMPANOS		
Caranx crysos - Blue runner	M	
C. hippos - Crevalle jack	M, B, F	N, SF
Decapterus macarellus - Mackeral scad	M	ST
C. punctatus - Round scad	M	ST
Selar crumenopthalmus - Big eye scad	M	
Selene vomer - Lookdown	M, B	ST
Seriola dumerili - Greater amberjack	M	ST
S. zonata - Banded rudderfish	M	ST
Trachinotus carolinus - Pompano	M	M, S, F
T. falcatus - Permit (Slaughter Beach, Lewes)	M	
Trachurus lathami - Rough scad	M	
Vomer setapinnis - Atlantic moonfish	M	

TABLE 4 (cont.)

Species	Type of Species	Primary Activity in Area
CORYPHAENIDAE - DOLPHINS		
Coryphaena hippurus - Dolphin	M	
POMADASYIDAE - GRUNTS		
Orthopristis chrysopterus - Pigfish	M	
SPARIDAE - PORGIES		
Lagodon rhomboides - Pinfish	M, B	ST
Stenotomus chrysops - Scup	M, B?	
EPHIPPIDAE - SPADEFISHES		
Chaetodipterus faber - Atlantic spadefish	M	ST
LUTJANIDAE - SNAPPERS		
Lutjanus griseus - Gray snapper	M, B, F	ST
Rhomboplites aurorubens - Vermilion snapper	M, B, F	ST
SCIAENIDAE - DRUMS		
Bairdiella chrysura - Silver perch	M, B, F	N, SF
Cynoscion regalis - Weakfish	M, B, F	N, SF
Leiostomus xanthurus - Spot	M, B, F	SF
Menticirrhus saxatilis - Northern kingfish	M, B	ST
Micropogon undulatus - Atlantic croaker	M, B, F	N, WF

TABL. 4(con..)

Species	Type of Species	Primary Activity in Area
Pogonias cromis - Black drum	M, B, F	N, SF
Sciaenops ocellata - Red drum	M, B, F?	
STROMATEIDAE - BUTTERFISHES		
Palinurichthys perciformis - Barrelfish	M	
Peprilus alepidotus - Harvestfish	M	
Poronotus triacanthus - Butterfish	M, B	SF
Psenes maculatus - Silver driftfish	M	
MUGILIDAE - MULLETS		
Mugil cephalus - Striped mulled	M, B, F	SF
M. curema - White mullet	M, B, F	ST
PHOLIDAE - GUNNELS		
Pholis gunnellus - Rock gunnel	M	
SPHYRAENIDAE - BARRACUDAS		
Sphyraena borealis - Northern sennet (Lewes)	M	
STICHAEIDAE - PRICKLEBACKS		
Ulvoria subbifurcata - Radiated shanny	M	
URANOSCOPIDAE - STARGAZERS		
Astroscopus y-graecum - Southern stargazer		
A. gur[illegible]us - Northern stargazer	M, B	S[illegible]

TABLE 4 (cont.)

Species	Type of Species	Primary Activity in Area
BLENNIIDAE - COMBTOOTH BLENNIES		
Chasmodes bosquianus - Striped blenny	M	
ANARHICHADIDAE		
Anarhichus lupus - Atlantic wolffish	M	ST
OPHIDIIDAE - CUSKEELS		
Rissola marginata - Striped Cuskeel	M, B	ST
ZOARCIDAE - EEL POUTS		
Macrozoarces americanus - Ocean pout	M	
GOBIIDAE - GOBIES		
Gobionellus boleosoma - Darter goby	M	
G. oceanicus - Highfin goby	M	
Gobiosoma bosci - Naked goby	M, B, F	N, SF
G. ginsburgi - Seaboard goby	N, B?	
Microgobius thalassinus - Green goby		
TRIGLIDAE - SEAROBINS		
Peristedion miniatum - Armored searobin	M	?SF
Prionotus carolinus - Northern searobin (off Bowers)	M	
P. evolans - Striped searobin	M, B	SF

TABLE 4 (cont.)

Species	Type of Species	Primary Activity in Area
COTTIDAE - SCULPINS		
<u>Hemitripterus</u> <u>americanus</u> - Sea raven	M	
<u>Myoxocephalus</u> <u>aenaeus</u> - Grubby		
<u>M.</u> <u>octodecem</u> <u>spinosus</u> - Long horn sculpin	M	
CYCLOPTERIDAE - LUMPFISHES AND SNAIL FISHES		
<u>Liparis</u> <u>liparis</u> - Striped Seasnail	M	ST
DACTYLOPTERIDAE - FLYING GURNARDS		
<u>Dactylop</u> <u>teridae</u> - Flying gurnard	M	
<u>Dactylopterus</u> <u>volitans</u> - Flying gurnard	M	ST
<u>Citharichthys</u> <u>spilopterus</u> - Bay whiff	M	
<u>Paralichthys</u> <u>oblongus</u> - Fourspot flounder	M, B	
AMMODYTIDAE - SAND LANCES		
<u>Ammodytes</u> <u>americanus</u> - American sand lance	M, B?	
CYNOGLOSSIDAE - TONGUEFISHES		
<u>Symphurus</u> <u>plagiusa</u> - Blackcheek tonguefish		
ECHENIDAE - REMORAS		
<u>Echeneis</u> <u>naucrates</u> - Sharksucker	M	ST
<u>Remora</u> <u>osteochir</u> - Marlin sucker	M	ST

TABLE (Cont.)

Species	Type of Species	Primary Activity in Area
R. remora - Remora	M	ST
BOTHIDAE - LEFTEYE FLOUNDER		
Citharichthys spilopterus - Bay Whiff	M	
Etropus grossotus - Fringed flounder		
E. microstomus - Smallmouth flounder	M, B	SF
Paralichthys dentatus - Summer flounder	M, B	SF
P. oblongus - Fourspot flounder	M, B	
Scophthalmus aquosus - Windowpane	M, B	SF
PLEURONECTIDAE - RIGHTEYE FLOUNDER		
Glyptocephalue cynoglossus - Witch flounder	M	
Limanda ferruginea - Yellowtail flounder	M, B	
Pseudopleuronectes americanus - Winter flounder	M, B, F	N, SF
SOLEIDAE - SOLES		
Trinectes maculatus - Hogchoker	M, B, F	N, SF
CHAETODONTIDAE - BUTTERFLY FISHES		
Chaetodon ocellatus	M	
Holacanthus bermudensis - Blue anglefish	M	
H. ciliaris - Queen angelfish	M	

TABL 4(cont.)

Species	Type of Species	Primary Activity in Area
LABRIDAE - WRASSES		
Tautoga onitis - Tautog	M	SP
Tautogolabrus adspersus - Cunner	M	
SCARIDAE - PARROT FISHES		
Scarus guacamaia	M	
TRICHIURIDAE - CUTLASS FISHES		
Trichiurus lepturus - Atlantic cutlass fish	M	
SCOMBRIDAE - MACKERALS AND TUNAS		
Acanthocybium solanderi - Wahoo	M	
Scomber japonicus - Chub mackeral	M	
Scomberomorus cavalla - King mackeral	M	
Thunnus alalunga - Albacore	M	
T. thynnus - Bluefin tuna	M	
Euthynnus alletteratus - Little tuna		
Sarda sarda - Atlantic bonito	M	
Scomber scombrus - Atlantic mackeral	M, B	
ISTIOPHORIDAE - BILLFISHES		
Makaira albida - White marlin	M	ST

TABLE 4 (Cont.)

Species	Type of Species	Primary Activity in Area
M. nigricans - Blue marlin	M	ST
XIPHIIDAE - SWORDFISHES		
Xiphias gladius - Swordfishes	M	ST
BALISTIDAE - TRIGGERFISHES AND FILEFISHES		
Aluterus schoepfi - Orange filefish (dead in river)	M, B?	ST
Balistes capriscus - Gray triggerfish	M	
Monacanthus hispidus - Planehead filefish	M	
TETRAODONTIDAE - PUFFERS		
Lagocephalus laevitagus - Smooth puffer	M	
Sphaeroides maculatus - Northern puffer	M, B	ST
PERCICHTHYIDAE - TEMPERATE BASSES		
Morone americana - White perch	B, F, M	R, SP
M. saxatilis - Striped bass	M, B, F	M (adults), R?, N, SF
PRIACANTHIDAE - BIG EYES		
Pristigenys alta - Short big eye	M, B	
CENTRARCHIDAE - SUNFISHES		
Enneacanthus chaetodon - Blackbanded sunfish (C & D Canal)	F	ST

TABI 4(cont.)

Species	Type of Species	Primary Activity in Are
Lepomis auritus - Redbreast sunfish (upper Blackbird Creek)	F	R, SP (upper cre
L. gibbosus - Pumpkinseed	F, B	R, SP
L. macrochirus - Bluegill	F, B	R, SP (in creek la
Micropterus salmoides - Largemouth bass	F, B	R, SP (in creek la
Pomoxis annularis - White crappie	F, B	R, SP
P. nigromaculatus - Black crappie	F, B	R, SP
PERCIDAE - PERCHES		
Etheostoma fusiforme	F, B	
E. olmstedi - Tessellated darter	F, B	R, SP
Perca flavescens - Yellow perch	F, B	R, SP
POMATOMIDAE - BLUEFISHES		
Pomatomus saltatrix - Bluefish	M, B, F	R, SP
DIODONTIDAE - PORCUPINE FISHES		
Chilomycterus schoepfi - Striped Burrfish	M	
OSTRACIIDAE		
Ostracion diaphanum - Spiny boxfish	M, B	
MOLIDAE		
Mola - Ocean sunfish	M	SP

TABLE 5 List of fishes collected from the Delaware River and four marsh creeks in the vicinity of Artificial Island in June, 1968, to January, 1971. Those species taken outside of, but adjacent to, the study area have the locality noted in parentheses after the common name. Type of species: M = Marine; B = Brackish (Sal. 1-10 ppt); F = Fresh. Primary activity in area: M = Migrant; SP = Spawning in Area; SF = Summer Feeding; WF = Winter Feeding; N = Nursery; R = Resident Species; ST = Stray.

Species	Type of Species	Primary Activity in Area
PETROMYZONTIDAE - LAMPREYS		
Petromyzon marinus-Sea lamprey	M, B, F	M
CARCHARHINIDAE - REQUIEM SHARKS		
Sandbar shark		
Carcharhinus obscurus-Dusky shark	M	ST
Mustelus canis-Smooth dogfish (Lewes)	M	
DASYATIDAE - STINGRAYS		
Dasyatis sabina-Atlantic stingray (off Bowers)	M	
MYLIOBATIDAE - EAGLE RAYS		
Rhinoptera bonasus-Cownose ray	M	ST
ACIPENSERIDAE - STURGEONS		
Acipenser oxyrhyncus-Atlantic sturgeon	M, B, F	M
ANGUILLIDAE - FRESHWATER EELS		
Anguilla rostrata-American eel	M, B, F	M, SF, N, R
CLUPEIDAE - HERRINGS		
Alosa aestivalis-Blueback herring	M, B, F	SP, N
Alosa mediocris-Hickory shad	M, B, F	M (adults), SF (young)
Alosa pseudoharengus-Alewife	M, B, F	SP, N
Alosa sapidissima-American shad	M, B, F	M
Brevoortia tyrannus-Atlantic menhaden	M, B, F	N, SF
Dorosoma cepedianum-Gizzard shad	F, B	R, SP

(Thomas 1971)

TABLE 5 continued

Species	Type of Species	Primary Activity in Area
ENGRAULIDAE - ANCHOVIES		
Anchoa hepsetus-Striped anchovy	M, B	ST
Anchoa mitchilli-Bay anchovy	M, B, F	SP?, N, SF
UMBRIDAE - MUDMINNOWS		
Umbra pygmacea-Eastern mudminnow	F	ST
ESOCIDAE - PIKES		
Esox americanus-Redfin pickerel	F, B	R, SP
Esox niger-Chain pickerel	F, B	R, SP
CYPRINIDAE - MINNOWS AND CARPS		
Carassius auratus-Goldfish	F, B	R, SP?
Cyprinus carpio-Carp	F, B	R, SP
Hybognathus nuchalis-Silvery minnow	F, B	R, SP
Notemigonus crysoleucas-Golden shiner	F, B	R, SP
Notropis analostanus-Satinfin shiner	F	R, SP (upper crk. lakes)
Notropis hudsonius-Spottail shiner	F, B	R, SP
Rhinichthys atratulus-Blacknose dace	F	ST
CATOSTOMIDAE		
Carpoides cyprinus-Quillback (C&D Canal)	F	ST
Catostomus commersoni-White sucker (upper marsh crks.)	F	R, SP (upper creeks)
Erimyzon oblongus-Creek chubsucker (upper marsh crks.)	F	R, SP (upper creeks)
ICTALURIDAE - FRESHWATER CATFISHES		
Ictalurus catus-White catfish	F, B	R, SP
Ictalurus nebulosus-Brown bullhead	F, B	R, SP
Ictalurus punctatus-Channel catfish	F, B	R, SP
Noturus gyrinus-Tadpole madtom (upper Blackbird Crk.)	F	R, SP (upper creeks)
BATRACHOIDIDAE - TOADFISHES		
Opsanus tau-Oyster toadfish	M, B	SF?

(Th. mas 1971)

TABLE 5 continued

Species	Type of Species	Primary Activity in Area
LOPHIIDAE - GOOSEFISHES		
Lophius americanus-Goosefish (Dead on beach at Bayview)	M, B?	ST
GADIDAE - CODFISHES		
Urophycis regius-Spotted hake	M, B	SP
OPHIDIIDAE - CUSK-EELS AND BROTULAS		
Rissola marginata-Striped cusk-eel	M, B	ST
EXOCOETIDAE - FLYINGFISHES AND HALFBEAKS		
Hyporhamphus unifasciatus-Halfbeak (Leves)	M	
BELONIDAE - NEEDLEFISHES		
Strongylura marina-Atlantic needlefish	M, B, F	N, SP
CYPRINODONTIDAE - KILLIFISHES		
Cyprinodon variegatus-Sheepshead minnow	M, B, F	SF
Fundulus diaphanus-Banded Killifish	F, B, M	R, SP
Fundulus heteroclitus-Mummichog	B, F, M	R, SP
Fundulus majalis-Striped Killifish	M, B	SF
POECILIIDAE - LIVEBEARERS		
Gambusia affinis-Mosquitofish	M, B, F	R, SP
ATHERINIDAE - SILVERSIDES		
Membras martinica-Rough silverside	M, R, F	SF, SP?
Menidia beryllina-Tidewater silverside	B, F, M	R, SP
Menidia menidia-Atlantic silverside	M, B, F	R, SP
GASTEROSTEIDAE - STICKLEBACKS		
A;eltes quadracus-Fourspine stickleback	M, B, F	WF
Gasterosteus aculeatus-Threespine stickleback	M, B, F	WF

(Thomas 1971)

TABLE 5 continued

Species	Type of Species	Primary Activity in Area
SYNGNATHIDAE - PIPEFISHES AND SEAHORSES		
Hippocampus erectus -Lined seahorse	M, B	ST
Syngnathus fuscus-Northern pipefish	M, B, F	N, SF
PERCICHTHYIDAE - TEMPERATE BASSES		
Morone americana-White perch	B, F, M	R, SP
Morone saxatilis-Striped bass	M, B, F	M (adults), R?, N, SF
CENTRARCHIDAE - SUNFISHES		
Enneacanthus chaetodon-Blackbanded sunfish (C&D Canal)	F	ST
Lepomis auritus-Redbreast sunfish (upper Blackbird Creek)	F	R, SP (upper creeks)
Lepomis gibbosus-Pumpkinseed	F, B	R, SP
Lepomis macrochirus-Bluegill	F, B	R, SP (in creek lakes)
Micropterus salmoides-Largemouth bass	F, B	R, S? (in creek lakes)
Pomoxis annularis-White crappie	F, B	R, SP
Pomoxis nigromaculatus-Black crappie	F, B	R, SP
PERCIDAE - PERCHES		
Etheostoma olmstedi-Tessellated darter	F, B	R, SP
Perca flavescens-Yellow perch	F, B	R, SP
POMATOMIDAE - BLUEFISHES		
Pomatomus saltatrix-Bluefish	M, B, F	N, SF
CARANGIDAE - JACKS AND POMPANOS		
Caranx hippos-Crevalle jack	M, B, F	N, SF
Selene vomer-Lookdown	M, B	ST
Trachinotus carolinus-Florida pompano (Slaughter Beach, Lewes)	M	
Trachinotus falcatus-Permit (Slaughter Beach, Lewes)	M	
Vomer setapinnis-Atlantic moonfish	M	
LUTJANIDAE - SNAPPERS		
Lutjanus griseus-Gray snapper	M, B, F	ST

(Thomas 1971)

TABLE 5 continued

Species	Type of Species	Primary Activity in Area
SPARIDAE - PORGIES		
Lagodon rhomboides-Pinfish (Woodland Beach)	M, B	ST
SCIAENIDAE - DRUMS		
Bairdiella chrysura-Silver perch	M, B, F	N, SF
Cynoscion regalis-Weakfish	M, B, F	N, SF
Leiostomus xanthurus-Spot	M, B, F	SF
Menticirrhus saxatilis-Northern kingfish	M, B	ST
Micropogon undulatus-Atlantic croaker	M, B, F	N, WF
Pogonias cromis-Black drum	M, B, F	N, SF
MUGILIDAE - MULLETS		
Mugil cephalus-Striped mullet	M, B, F	SF
Mugil curema-White mullet	M, B, F	ST
SPHYRAENIDAE - BARRACUDAS		
Sphyraena borealis-Northern sennet (Lewes)	M	
URANOSCOPIDAE - STARGAZERS		
Astroscopus guttatus-Northern stargazer	M, B	ST
GOBIIDAE - GOBIES		
Gobiosoma bosci-Naked goby	M, B, F	N, SF
STROMATEIDAE - BUTTERFISHES		
Peprilus triacanthus-Butterfish	M, B	SF
TRIGLIDAE - SEAROBINS		
Prionotus carolinus-Northern searobin (off Bowers)	M	
Prionotus evolans-Striped searobin	M, B	SF

(Thomas 1971)

TABLE 5 continued

Species	Type of Species	Primary Activity in Area
BOTHIDAE - LEFTEYE FLOUNDER		
Etropus microstomus-Smallmouth flounder	M, B	ST
Paralichthys dentatus-Summer flounder	M, B	ST
Scophthalmus aquosus-Windowpane	M, B	ST
PLEURONECTIDAE - RIGHTEYE FLOUNDER		
Pseudopleuronectes americanus-Winter flounder	M, B, F	N, SF
SOLEIDAE - SOLES		
Trinectes maculatus-Hogchoker	M, B, F	N, SF
BALISTIDAE - TRIGGERFISHES AND FILEFISHES		
Aluterus schoepfi-Orange filefish (Dead in river)	M, B?	ST
TETRAODONTIDAE - PUFFERS		
Sphaeroides maculatus-Northern puffer	M, B	ST

(Thomas 1971)

TABLE 6 Fish catch composition in Delaware Bay by years and for the total sampling period. 1966 was only sampled from August through December.

Species	1966 #	1966 %	1967 #	1967 %	1968 #	1968 %	1969 #	1969 %	1970 #	1970 %	Total Period #	Total Period %
Sand Shark	2	0.01	14	0.04	3	0.01	2	0.01	1	0.01	22	0.02
Sandbar Shark	14	0.04	37	0.10	1	0.00	4	0.02	4	0.02	60	0.04
Smooth Dogfish	652	1.83	799	2.09	637	2.85	605	2.74	643	2.74	643	3.61
Spiny Dogfish	84	0.24	125	0.33	51	0.23	49	0.22	105	0.59	414	0.30
Atlantic Angel Shark	1	0.00	-	-	2	0.01	-	-	1	0.01	4	0.00
Clearnose Skate	592	1.66	1087	2.84	352	1.57	231	1.04	109	0.61	2371	1.74
Little Skate	19	0.05	49	0.13	63	0.28	34	0.15	52	0.29	217	0.16
Winter Skate	-	-	29	0.08	2	0.01	-	-	1	0.01	32	0.02
Roughtail Stingray	77	0.22	81	0.21	112	0.50	158	0.71	138	0.78	566	0.42
Bluntnose Stingray	66	0.19	72	0.19	4	0.02	7	0.03	82	0.46	231	0.17
Smooth Butterfly Ray	-	-	2	0.01	-	-	6	0.03	-	-	8	0.01
Spiny Butterfly Ray	6	0.02	-	-	3	0.01	1	0.00	1	0.01	11	0.01
Bullnose Ray	54	0.15	123	0.32	72	0.32	102	0.46	104	0.58	455	0.33
Cownose Ray	-	-	-	-	-	-	44	0.20	-	-	44	0.03
Atlantic Sturgeon	2	0.01	-	-	-	-	-	-	-	-	2	0.00
Blueback Herring	-	-	5	0.01	5	0.02	-	-	9	0.05	19	0.01
Hickory Shad	-	-	45	0.12	1	0.00	-	-	6	0.03	52	0.04
Alewife	21	0.06	59	0.15	27	0.12	15	0.07	19	0.11	141	0.10
Atlantic Menhaden	-	-	23	0.06	23	0.10	11	0.05	13	0.07	70	0.05
Atlantic Herring	1	0.00	464	1.21	344	1.54	350	1.58	88	0.49	1247	0.92
Gizzard Shad	-	-	4	0.01	4	0.02	-	-	-	-	8	0.01
Striped Anchovey	1	0.00	8	0.02	2	0.01	-	-	14	0.08	25	0.02
Bay Anchovey	24	0.07	1	0.00	1	0.00	4	0.02	7	0.04	37	0.03
Conger Eel	1	0.00	-	-	-	-	-	-	1	0.01	2	0.00
Striped Killifish	-	-	-	-	1	0.00	-	-	-	-	1	0.00
Silver Hake	41	0.12	549	1.44	481	2.15	69	0.31	27	0.15	1167	0.86
Squirrel Hake	89	0.25	838	2.19	145	0.65	38	0.17	58	0.33	1168	0.86
Spotted Hake	48	0.13	1311	3.43	471	2.10	81	0.37	266	1.50	2177	1.60
Threespine Stickleback	-	-	-	-	2	0.01	-	-	-	-	2	0.00
Black Seabass	5	0.01	10	0.03	5	0.02	23	0.10	18	0.10	61	0.04
White Perch	113	0.32	485	1.27	750	3.35	6	0.03	17	0.10	1371	1.01

TABLE 5 (cont.)

Species	1966 #	1966 %	1967 #	1967 %	1968 #	1968 %	1969 #	1969 %	1970 #	1970 %	Total Period #	Total Period %
Striped Bass	1	0.00	58	0.15	82	0.37	1	0.00	11	0.06	153	0.11
Snowy Grouper	-	-	-	-	-	-	1	0.00	-	-	1	0.00
Bluefish	20	0.06	7	0.02	2	0.01	3	0.01	11	0.06	43	0.03
Blue Runner	-	-	2	0.01	4	0.02	2	0.01	-	-	8	0.01
Lookdown	-	-	5	0.01	-	-	3	0.01	1	0.01	9	0.01
Pig Fish	3	0.01	2	0.01	-	-	-	-	3	0.02	8	0.01
Silver Perch	137	0.39	24	0.06	13	0.06	47	0.21	224	1.26	445	0.33
Weakfish	11315	31.82	10572	27.64	6083	27.18	7841	35.46	6464	36.34	42275	31.06
Northern Kingfish	136	0.38	119	0.31	117	0.52	65	0.29	63	0.35	500	0.37
Spot	1731	4.87	4	0.01	-	-	1683	7.61	76	0.43	3494	2.57
Black Drum	1838	5.17	79	0.21	10	0.04	143	0.65	116	0.65	2186	1.61
Atlantic Croaker	-	-	-	-	-	-	-	-	4	0.02	4	0.00
Scup	5253	14.77	9650	25.23	593	2.65	445	2.01	1699	9.55	17640	12.96
Tautog	2	0.01	19	0.05	1	0.00	8	0.04	5	0.03	35	0.03
Northern Searobin	808	2.27	2225	5.82	1009	4.51	585	2.65	405	2.28	5032	3.70
Striped Searobin	106	0.30	303	0.79	159	0.71	158	0.71	324	1.82	1050	0.77
Sea Raven	-	-	1	0.00	-	-	-	-	-	-	1	0.00
Grubby	-	-	-	-	5	0.02	-	-	1	0.01	6	0.00
Longhorn Sculpin	6	0.02	495	1.29	1330	5.94	403	1.82	251	1.41	2485	1.83
Sea Snail	-	-	-	-	1	0.00	1	0.00	-	-	2	0.00
Northern Stargazer	22	0.06	2	0.01	-	-	1	0.00	-	-	25	0.02
Ocean Pout	-	-	-	-	10	0.04	7	0.03	7	0.04	24	0.02
Striped Cusk-Eel	-	-	-	-	13	0.06	-	-	-	-	13	0.01
Butterfish	52	0.15	1115	2.91	371	1.66	17	0.08	310	1.74	1865	1.37
Striped Mullet	-	-	-	-	-	-	1	0.00	1	0.01	2	0.00
Fringed Flounder	20	0.06	29	0.08	82	0.37	10	0.05	26	0.15	167	0.12
Summer Flounder	219	0.62	161	0.42	88	0.39	135	0.61	61	0.34	664	0.49
Fourspot Flounder	5	0.01	3	0.01	8	0.04	3	0.01	2	0.01	21	0.02
Windowpane	1087	3.06	1534	4.01	1619	7.23	964	4.36	827	4.65	6031	4.43
Winter Flounder	5	0.01	277	0.72	188	0.84	69	0.31	74	0.42	613	0.45
Hogchoker	8565	24.09	4522	11.82	6391	28.56	6778	30.65	4628	26.02	30884	22.69
Orange Filefish	1	0.00	1	0.00	-	-	1	0.00	8	0.04	11	0.01
Planehead Filefish	-	-	-	-	1	0.00	1	0.00	-	-	2	0.00

TABLE 6 (cont.)

Species	YEARS											
	1966		1967		1968		1969		1970		Total Period	
	#	%	#	%	#	%	#	%	#	%	#	%
Northern Puffer	842	2.37	563	1.47	581	2.60	427	1.93	125	0.70	2538	1.86
Striped Burrfish	8	0.02	3	0.01	4	0.02	9	0.04	2	0.01	26	0.02
Oyster Toadfish	1465	4.12	248	0.65	47	0.21	459	2.08	271	1.52	2490	1.83
Goosefish	1	0.00	8	0.02	3	0.01	4	0.02	3	0.02	19	0.01
TOTAL	35561	100.00	38251	100.00	22379	100.00	22115	100.00	17787	100.00	136093	100.00

(Daiber and Smith 1971)

TABLE 7 Streams Known to Have Anadromous Clupeid Spawning Runs in Salem, Cumberland and Cape May Counties, New Jersey

Gloucester and Salem Counties - Delaware River Drainage

Oldmans Creek-alewife

Salem County-Delaware River Drainage

Beaver Creek-alewife - Oldmans Creek Drainage
Fenwick Creek-alewife - Salem River Drainage
Mannington Creek-alewife - Salem River Drainage
Salem River-alewife
Deep Run-alewife - Alloway Creek Drainage
Buckshutem Creek-alewife - Maurice River Drainage
Menantico Creek-alewife - Maurice River Drainage
Greenies Sandwash-alewife - Maurice River Drainage
Hankins Brook-alewife - Maurice River Drainage
White Marsh Run-alewife - Maurice River Drainage
Maurice River-blueback
Raceway-alewife - Maurice River Drainage
Maurice River-alewife

Cumberland and Cape May Counties-Delaware Bay Drainage

West Creek-alewife - Delaware Bay Drainage
Alloway Creek-alewife

Salem and Cumberland Counties-Delaware River Drive

Raccoon Ditch-alewife - Stow Creek Drainage
Stow Creek-alewife
Mill Creek-blueback - Cohansey River Drainage
Mill Creek-alewife - Cohansey River Drainage
Cohansey River-blueback
Cohansey River-alewife
Cedar Creek-blueback
Cedar Creek-alewife
Muskee Creek-alewife - Maurice River Drainage
Manumuskin River-alewife - Maurice River Drainage

Table 8

List of species obtained from transect samples in Delaware Bay during 1972 and 1973

	Feeding* Type	Transects 1-13	Transects 14-26
Phylum Cnidaria			
Class Hydrozoa			
Order Hydroida			
Family Hydractiniidae			
Hydractinia echinata (Fleming 1828)	SF		x
Family Campanulariidae			
Hartlaubella gelatinosa (Pallas 1766)	SF	x	
Family Sertulariidae			
Sertularia argentea Linne 1758	SF	x	
Family Plumulariidae			
Schizotricha tenella (Verrill 1874)	SF	x	
Class Anthozoa			
Order Actinaria			
Family Diadumenidae			
Diadumene leucolena (Verrill 1866)	SF	x	
Phylum Rhynchocoela			
Class Anopla			
Order Heteronemertini			
Family Lineidae			
Cerebratulus lacteus (Leidy 1851)	C	x	x
Micrura leidyi	C	x	
Class Unknown			
Nemertea sp.	C	x	x
Phylum Annelida			
Family Ampharetidae			
Asabellides oculatus (Webster 1879)	DF	x	x
Melinna sp. cf. *M. maculata*	DF	x	
Asabellides sp. cf. *A. oculatus*	DF	x	
? *Asabellides*	DF		x
Ampharetidae sp. 1	DF		x
Family Arabellidae			
Arabella iricolor (Montagu 1804)	O		x
Drilonereis longa Webster 1879	O	x	x
Drilonereis magna Webster and Benedict 1887	O		x
Family Capitellidae			
Capitella capitata (Fabricius 1780)	DF	x	x
Heteromastus filiformis (Claparede 1864)	DF	x	x

Table 8 (cont.)

	Feeding Type	Transects 1-13	Transects 14-26
Family Cirratulidae			
Caulleriella sp. 2	DF		x
Tharyx sp. 2	DF	x	x
Cirriformia sp. cf. *C. grandis*	DF	x	
? *Chaetozone*	DF		x
Family Eunicidae			
Marphysa sanguinea (Montagu 1815)	DF		x
Family Glyceridae			
Glycera americana Leidy 1855	C	x	x
Glycera capitata Oersted 1843	C		x
Glycera dibranchiata Ehlers 1868	C	x	x
Glycera robusta Ehlers 1868	C	x	
Family Goniadidae			
Glycinde solitaria (Webster 1880)	C	x	x
Family Hesionidae			
Microphthalmus aberrans (Webster and Benedict 1887)	C		x
Family Lumbrineridae			
Lumbrineris acuta (Verrill 1875)	DF	x	
Lumbrineris tenuis (Verrill 1873)	DF	x	x
Lumbrineris sp. cf. *L. tenuis* (Verrill 1873)	DF	x	
Family Magelonidae			
Magelona sp. 1	DF	x	
Magelona sp. 2	DF		x
Magelona sp. 4	DF	x	
Family Maldanidae			
Clymenella sp. cf. *C. torquata* (Leidy 1855)	DF	x	
Family Nephtyidae			
Nephtys bucera Ehlers 1868	O		x
Nephtys picta Ehlers 1868	O	x	x
Family Nereidae			
Nereis (Neanthes) succinea Frey and Leuckart 1847	O	x	x
Family Opheliidae			
Ophelia bicornis Savigny 1818	DF		x
Travisia carnea Verrill 1873	DF		x
Family Orbiniidae			
Haploscoloplos acutus (Verrill 1873)	DF		x
Haploscoloplos fragilis (Verrill 1873)	DF	x	x
Haploscoloplos robustus (Verrill 1873)	DF	x	x
Orbinia ornatus (Verrill 1873)	DF	x	
Scoloplos sp.	DF	x	
Family Paraonidae			
Aricidea sp.	DF		x
Aricidea cerruti Laubier 1967	DF		x
Paradoneis (Paraoinides) lyra Southern 1914	DF	x	

Table 8 (cont.)

	Feeding Type	Transects 1-13	Transects 14-26
Family Pectinariidae			
Pectinaria gouldii Verrill 1873	DF	x	
Family Phyllodocidae			
Eteone heteropoda Hartman 1951	O	x	x
Eteone lactea Claparede 1868	O		x
Eteone longa (Fabricius 1780)	O		x
Eumida sanguinea (Oersted 1843)	O	x	
Paranaitis kosteriensis (Malmgren 1867)	C		x
Phyllodoce arenae Webster 1880	C		x
Family Polynoidae			
Harmothoe sp. cf. H. extenuata (Grube 1840)	C	x	
Harmothoe (Lagisca) extenuata (Grube 1840)	C	x	x
Lepidonotus squamatus (Linnaeus 1756)	C		x
Lepidonotus sublevis Verrill 1873	C	x	x
Family Sabellaridae			
Sabellaria vulgaris Verrill 1873	SF	x	x
Family Sabellidae			
Potamilla reniformis (Leuchart 1849)	SF		x
Family Serpulidae			
Hydroides dianthus (Verrill 1873)	SF		x
Family Sigalionidae			
Sthenelais (denticulatum)	C	x	
Sigalion sp.	C	x	
Family Spionidae			
Polydora ligni Webster 1879	DF	x	x
Polydora socialis (Schmarda 1861)	DF		x
Polydora websteri Hartman 1943	DF		x
Scolecolepides viridis (Verrill 1873)	DF	x	x
Scolelepis squamata (O.F. Muller 1806)	DF		x
Spiophanes bombyx (Claparede 1870)	DF	x	x
Streblospio benedicti Webster 1879	DF	x	x
Family Syllidae			
Exogone verugera (Claparede 1868)	O	x	
Parapionosyllis longicirrata Webster and Benedict 1884)	O		x
Proceraea cornuta (Agassiz 1863)	O		x
Family Terebellidae			
Polycirrus eximius (Leidy 1855)	DF		x
Class Oligochaeta			
Oligochaeta	DF	x	
Phylum Mollusca			
Class Gastropoda			
Order Mesogastropoda			
Family Epitoniidae			
Epitonium rupicola (Kurtz 1860)	C	x	
Family Calyptraeidae			
Crepidula fornicata (Linne 1758)	SF		x
Crepidula convexa Say 1822	SF	x	x
Crepidula plana Say 1822	SF		x

Table 8 (cont.)

	Feeding Type	Transects 1-13	Transects 14-26
Family Naticacea			
Lunatia heros (Say 1822)	C		x
Order Neogastropoda			
Family Melongenidae			
Busycon carica (Gmelin 1791)	C		x
Family Nassariidae			
Nassarius trivittatus (Say 1822)	C	x	x
Ilyanassa obsoletus (Say 1822)	C	x	x
Family Marginellidae			
Marginella roscida Redfield 1860	C	x	
Order Tectibranchia			
Family Pyramidellidae			
Sayella fusca (C.B. Adams 1839)	ectoparasitic		x
Order Nudibranchia			
Family Corambella			
Dorodella obscura Verrill 1870	C	x	x
Class Bivalvia			
Order Protobranchia			
Family Nuculidae			
Nucula proxima Say 1822	DF	x	x
Yoldia limatula Say 1831	DF	x	x
Order Filibranchia			
Family Arcidae			
Anadara ovalis (Bruguiere 1789)	SF		x
Family Mytilidae			
Geukensia demissa (Dillwyn 1817)	SF		x
Mytilus edulis Linne 1758	SF		x
Family Ostreidae			
Crassostrea virginica (Gmelin 1791)	SF	x	x
Order Eulamellibranchia			
Family Carditidae			
Cyclocardia borealis (Conrad 1831)	SF	x	
Family Leptonidae			
Mysella planulata (Stimpson 1857)	SF		x
Family Veneridae			
Mercenaria mercenaria (Linne 1758)	SF	x	x
Gemma gemma (Totten 1834)	SF	x	x
Family Tellinidae			
Tellina agilis Stimpson 1857	DF	x	x
Macoma balthica (Linne 1758)	DF	x	x
Family Solenidae			
Ensis directus Conrad 1843	SF	x	x
Family Mactridae			
Spisula solidissima (Dillwyn 1817)	SF	x	x
Mulinia lateralis (Say 1822)	SF	x	x
Family Myacidae			
Mya arenaria Linne 1758	SF	x	x

Table 8 (cont.)

	Feeding Type	Transects 1-13	14-26
Family Corbulidae			
Corbula contracta Say 1822	SF	x	x
Family Lyonsiidae			
Lyonsia hyalina Conrad 1831	SF	x	x
Family Pandoridae			
Pandora gouldiana Dall 1886	SF		x
Phylum Arthropoda			
Class Merostomata			
Limulus polyphemus (Linne 1758)	C		x
Class Pycnogonida			
Family Pallenidae			
Tanystylum orbiculare Wilson 1878	DF	x	x
Class Crustacea			
Subclass Cirripedia			
Order Thoracica			
Family Balanidae			
Balanus (Balanus) improvisus Darwin 1854	SF		x
Balanus (Semibalanus) balanoides (Linne)	SF		x
Subclass Malacostraca			
Order Mysidacea			
Family Mysidae			
Neomysis americana (S.I. Smith 1873)	SF	x	x
Order Cumacea			
Family Diastylidae			
Oxyurostylis smithi Calman 1912	DF		x
Order Isopoda			
Family Anthuridae			
Cyathura polita (Stimpson 1855)	0	x	x
Ptilanthura tenuis Harger 1878	0		x
Cyathura burbancki Frankenberg 1965	0		x
Family Idoteidae			
Chiridotea nigrescens Wigley 1961	DF		x
Edotea triloba (Say 1818)	DF		x
Order Amphipoda			
Family Ampeliscidae			
Ampelisca abdita Mills 1964	DF	x	x
Ampelisca verrilli Mills 1967	DF	x	x
Family Ampithoidae			
Ampithoidae sp.	DF	x	
Family Aoridae			
Lembos smithi (Holmes 1905)	DF		x
Family Bateidae			
Batea catharinensis Fr. Muller 1865	DF	x	
Family Corophiidae			
Corophium insidiosum Crawford 1937	DF	x	x
Corophium lacustre Vanhoffen 1911	DF	x	
Corophium tuberculatum Shoemaker 1934	DF	x	x
Erichthonius brasiliensis Dana 1853	DF	x	x

Table 8 (cont.)

	Feeding Type	Transects 1-13	Transects 14-26
Family Corophiidae (cont.)			
Unciola irrorata Say 1818	DF	x	
Unciola serrata Shoemaker 1945	DF	x	x
Unciola dissimilis Shoemaker 1945	DF	x	
Corophium simile Shoemaker 1934	DF	x	x
Family Gammaridae			
Gammarus mucronatus Say 1818	DF	x	x
Elasmopus laevis (Smith 1871)	DF		x
Melita nitida Smith 1873	DF	x	x
Family Haustoriidae			
Parahaustorius attenuatus Bousfield 1965	DF	x	
Parahaustorius longimerus Bousfield 1965	DF	x	
Protohaustorius wigleyi Bousfield 1965	DF	x	x
Protohaustorius deichmannae Bousfield 1965	DF	x	
Acanthohaustorius millsi Bousfield 1965	DF	x	x
Acanthohaustorius intermedius Bousfield 1965	DF		x
Family Lysianassidae			
Lysianopsis alba Holmes 1905	DF	x	
Family Phoxocephalidae			
Paraphoxus spinosus Holmes 1903	DF		x
Trichophoxus epistomus (Shoemaker 1938)	DF	x	
Family Pleustidae			
Parapleustes aestuarius Watling and Maurer 1973	DF	x	x
Family Stenothoidae			
Parametopella cypris (Holmes 1905)	DF		x
Family Caprellidae			
Paracaprella tenuis Mayer 1903	SF	x	x
Order Decapoda			
Family Crangonidae			
Crangon septemspinosa (Say 1818)	DF	x	x
Family Callianassidae			
Callianassa sp. cf. *C. atlantica*	DF	x	
Family Paguridae			
Pagurus longicarpus Say 1817	DF	x	x
Family Cancridae			
Cancer irroratus Say 1817	C	x	x
Family Xanthidae			
Xanthid sp.	C	x	
Eurypanopeus depressus (Smith 1869)	C	x	x
Neopanope texana sayi (Smith 1869)	C	x	x
Rhithropanopeus harrisi (Gould 1841)	C		x
Family Pinnotheridae			
Pinnotheres maculatus Say 1818	commensal		x
Pinnixa sayana Stimpson 1860	DF	x	x

Table 8 (cont.)

	Feeding Type	Transects 1-13	Transects 14-26
Phylum Ectoprocta			
Class Gymnolaemata			
Order Ctenostomata			
Family Alcyonidiidae			
Alcyonidium polyoum (Hassall 1841)	SF	x	x
Alcyonidium verrilli Osburn 1912	SF		x
Family Nolellidae			
Anguinella palmata Van Beneden 1844	SF	x	
Family Flustrellidae			
Flustrellidra hispida (Fabricius 1780)	SF	x	
Family Vesiculariidae			
Bowerbankia gracilis Leidy 1855	SF	x	
Family Triticellidae			
Triticella elongata (Osburn 1912)	SF	x	
Order Cheilostomata			
Family Membraniporidae			
Membranipora tenuis Desor 1848	SF	x	x
Membranipora tuberculata (Bosc 1802)	SF		x
Conopeum tenuissimum (Canu 1908)	SF	x	x
Family Electridae			
Electra hastingsae Marcus 1938	SF	x	x
Family Schizoporellidae			
Schizoporella errata (Watess 1878)	SF		x
Family Microporellidae			
Microporella ciliata (Pallas 1766)	SF		x
Phylum Echinodermata			
Class Echinoidea			
Order Diadematoida			
Family Echinarachnidae			
Echinarachnius parma (Lamark 1816)	SF		x

Source: Watling, Maurer and Wethe, 1976

*SF = Suspension Feeder
DF = Deposit Feeder
C = Carnivore
O = Omnivore

Table 9 Commercial Fish and Shellfish Landings in Delaware Bay and River, 1955-1977*

Year	New Jersey Pounds	New Jersey Dollars	Delaware Pounds	Delaware Dollars	Total Pounds	Total Dollars
1955	6,027,125	2,611,829	6,359,700	1,290,374	12,386,825	3,902,203
1956	6,229,300	2,963,116	6,280,700	1,182,417	12,510,000	4,145,533
1957	4,364,100	1,874,694	10,035,500	3,890,741	14,399,600	5,765,435
1958	2,437,200	664,939	N/A	N/A	-	-
1959	1,507,040	277,194	N/A	N/A	-	-
1960	2,076,700	294,928	2,622,250	383,940	4,698,950	678,868
1961	3,267,200	967,519	1,511,400	257,001	4,778,600	1,224,520
1962	3,109,000	1,545,010	2,647,800	317,431	5,756,800	1,862,441
1963	2,188,100	658,494	1,036,900	161,243	2,846,594	819,737
1964	2,489,700	1,087,365	911,400	183,972	3,401,100	1,271,337
1965	2,133,700	767,541	994,400	122,468	3,128,100	890,009
1966	1,858,500	839,873	841,500	89,593	2,700,000	929,466
1967	2,444,300	1,080,500	449,800	82,798	2,893,800	1,163,298
1968	1,934,100	1,091,083	396,300	98,147	2,330,400	1,189,230
1969	1,874,100	889,716	675,800	112,587	2,549,900	788,387
1970	1,686,900	624,945	1,066,200	281,036	2,753,100	905,981
1971	2,173,800	842,036	1,723,200	514,964	3,897,000	1,357,000
1972	3,390,500	1,694,665	3,822,800	1,249,739	7,213,300	2,944,404
1973	4,178,600	1,912,128	3,638,700	1,264,597	7,817,300	3,176,725
1) 1974	45,948,900	2,716,196	2,930,300	751,270	48,879,200	3,467,466
1975	5,234,200	1,551,321	4,230,200	1,160,831	9,464,400	2,712,152
1976	2,384,700	2,111,317	6,321,900	1,683,187	8,706,600	3,794,504
1977	2,008,300	1,577,672	2,045,300	704,206	4,053,600	2,281,878

N/A - Not available

1) - Menhaden landings for this year were 42,186,800 pounds valued at $1,060,861.

* - Source: National Marine Fisheries Service, Department of Commerce

Table 10 Commercial Fish and Shellfish Landings in Delaware Bay and River, 1977*

Species	New Jersey Pounds	New Jersey Dollars	Delaware Pounds	Delaware Dollars	Total Pounds	Total Dollars
Alewives	1,000	66	-	-	1,000	66
Bluefish	33,200	3,252	31,100	3,081	64,300	6,333
Butterfish	-	-	100	24	100	24
Carp	34,700	3,431	28,000	2,520	62,700	5,951
Catfish	3,600	542	10,100	1,414	13,700	1,956
Croaker	3,300	514	8,900	1,841	12,200	2,355
Drum, red	-	-	200	13	200	13
Drum, black	11,000	1,649	-	-	11,000	1,649
Eels, common	17,800	6,671	95,900	49,281	113,700	55,952
Fluke	300	124	4,500	2,111	4,800	2,235
Herring, sea	1,100	41	-	-	1,100	41
Mackerel, Atlantic	-	-	500	77	500	77
Menhaden	41,900	2,016	24,600	984	66,500	3,000
Sea trout, gray	148,600	26,850	296,000	63,403	444,600	90,253
Shad	38,200	7,013	64,200	13,428	102,400	20,441
Sharks, grayfish	-	-	300	16	300	16
Spot	8,600	1,495	3,700	934	12,300	2,429
Striped bass	5,100	2,283	45,400	32,557	50,500	34,840
Sturgeon	200	31	-	-	200	31
White perch	17,000	3,539	21,000	6,907	38,000	10,446
Unclassified for food	400	71	1,300	185	1,700	256
Crabs, blue	296,800	112,716	878,200	322,560	1,175,000	435,276
Horseshoe crabs	-	-	400,000	4,000	400,000	4,000
Lobster, American	-	-	700	1,750	700	1,750
Oysters	1,218,200	1,400,372	127,500	196,190	1,345,700	1,596,562
Turtles, snapper	22,400	4,996	3,100	930	25,500	5,926
TOTAL	2,008,300	1,577,672	2,045,300	704,206	4,053,600	2,281,878

* Source: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service

Table 11 Ten most valuable commercial species landed in New Jersey from Delaware Bay, 1948 - 1977*

Species	Value	% of Total Landings	Pounds	% of Total Landings
Oyster	41,827,373	85.6	77,277,515	45.0
Blue crab	3,875,049	7.9	24,263,860	14.1
Menhaden	1,209,176	2.5	47,040,198	27.4
Hard clam	504,973	1.0	1,591,860	0.9
Striped bass	319,452	0.7	1,349,391	0.8
Eel	265,535	0.5	844,100	0.5
Shad	241,342	0.5	1,710,995	1.0
Weakfish	238,204	0.5	1,521,852	0.9
White perch	108,265	0.2	689,805	0.4
Carp	79,541	0.2	1,189,608	0.7
		99.6		91.7

* Source: Prepared from data supplied by the National Marine Fisneries Service, Department of Commerce

Table 12 U.S. Department of the Interior Designated Threatened/Endangered Species in the Lower Delaware River and Bay Region *

Species	Delaware	New Jersey	Pennsylvania
Blue whale, *Balaenoptera musculus* (E)	X	X	
Bowhead whale, *Balaena mysticetus* (E)	X	X	–
Finback whale, *Balaenoptera physalus* (E)	X	X	–
Humpback whale, *Megaptera novaeangliae* (E)	X	X	–
Right whale, *Eubalaena* spp. (E)	X	X	–
Sei whale, *Balaenoptera borealis* (E)	X	X	–
Sperm whale, *Physeter catodon* (E)	X	X	–
Bald eagle, *Haliaeetus leucocephalus* (E)	X	X	X
American peregrine falcon, *Falco peregrinus anatum* (E)	X	X	X
Arctic peregrine falcon, *Falco peregrinus tundrius* (E)	X	X	X
Brown pelican, *Pelecanus occidentalis* (E)	X	X	
Green sea turtle, *Chelonia mydas* (T)	X	X	–
Hawksbill sea turtle, *Eretmochelys imbricata* (E)	X	X	–
Atlantic Ridley sea turtle, *Lepidochelys kempi* (E)	X	X	–
Leatherback sea turtle, *Dermochelys coriacea* (E)	X	X	–
Loggerhead sea turtle, *Caretta caretta* (T)	X	X	–
Shortnose sturgeon, *Acipenser brevirostrum* (E)	X	X	X

(E) - Endangered
(T) - Threatened

* Source: Federal Register - January 17, 1979

TABLE 13 - Recent Catches of the Shortnose Sturgeon in the Delaware River

Year	Location	Gear Description	Season	Number (Size)
1972	Del. R. RM 102-124	16 ft. semi-ballon otter trawl-fished on bottom	Oct-Nov	1 (400 mm)
1975	Mercer Power Plant RM 131	Four intake screens	August	1 (616 mm)
1977	Trenton, N.J. RM 131	700 ft x 8 ft experimental gill nets, 2.0, 3.0, 4.0, 5.0 stretch measure	June	2 (769 mm) (640 mm)

*Source: The Delaware River Basin Anadromous Fis ery Project

TABLE 14 - State of New Jersey, Department of Environmental Protection Designated Threatened/Endangered Species in the Lower Delaware River and Bay Region*

Shortnose sturgeon	Acipenser brevirostrum	(E)
Atlantic sturgeon	Acipenser oxyrhynchus	(T)
American shad	Alosa sapidissima	(T)
Southern gray treefrog	Hyla chrysoscelis	(E)
Eastern mud salamander	Pseudotriton montanus	(T)
Bog turtle	Clemmys muhlenbergi	(E)
Wood turtle	Clemmys insculpta	(T)
Indiana bat	Olyotis sodalis	(E)

Endangered (E) - A species whose prospects for survival in the state are in immediate danger due to one or many factors.

Threatened (T) - May become endangered if conditions surrounding the species begin to or continue to deteriorate.

*Source: New Jersey Department of Environmental Protection, Division of Fish Game and Shellfisheries.

TABLE 15 - Pennsylvania Fish Commission Designated Endangered/ Threatened Fishes, Amphibians and Reptiles in the Lower Delaware River Region*

Shortnose sturgeon	Acipenser brevirostrum	(E)
Threespine stickleback	Gasterosteous oculeatus	(E)
Eastern tiger salamander	Ambystoma tigrinum	(E)
New Jersey chorus frog	Pseudacris triseriata	(E)
Coastal plain leopard frog	Rana utricularia	(E)
Eastern mud turtle	Kinosternon subrubrum	(E)
Red-bellied turtle	Chrysemys rubriventris	(E)
Bog turtle	Clemmys muhlenbergi	(E)

(E) = Endangered

(T) = Threatened

*Source: Pennsylvania Fish Commission

Acipenser brevirostrum Lesueur, Shortnose sturgeon

ADULTS

D 33[17]–42;[1] A. 18–24;[9] C. 60; P. 30–31; V. 17–21;[18] dorsal shields 7[9]–13;[2] lateral shields 22[11]–34;[9] ventral shields 6[9]–11; gill rakers on first arch 22[2]–32.[9]

Proportions expressed as percent FL: Head length 18–22.[19] Proportions expressed as percent HL: Postorbital distance 51[2]–62, interorbital width 31–40;[19] snout length 37–50. Proportions expressed as percent snout length: Mouth width 44–77.[9] Proportions expressed as percent postorbital distance: Snout length 64–89.[19] Proportions expressed as percent interorbital width: Mouth width 63–90.[9] Proportions expressed as times in TL: Greatest depth 6.75, head 4.80. Proportions expressed as times in HL: Eye ca. 14.[9]

Body elongate,[9] pentagonal in cross-section,[1] with 5 rows of enlarged shields.[2] Head large, convex, depressed between eyes,[18] snout, as compared to *A. oxyrhynchus* of similar size, shorter, more blunt, proportionately wider at base.[17] 4 barbels in ventral transverse row 1/3 to 1/2 distance from snout tip to upper lip.[2] Mouth width inside lips more than 3/5 width of bony orbit.[9] Eye small,[9] pupil rounded;[1] gill rakers rather long, triangular.[2] Shields regular, oblong, with sharp keel,[15] space separating dorsal shields as much as 1/2 length of shields themselves.[9] Postdorsal and preanal shields *single or paired*. No enlarged bony plates between base of anal fin and lateral row of shields.[9] Upper lobe of caudal much longer than lower, dorsal fin just before caudal peduncle; anal fin under posterior portion of dorsal fin; pectoral fins just behind gill openings; ventral fins at beginning posterior 1/3 of body.[6]

Pigmentation: Brown above, tinged with copper on the sides (WLD), below lateral shields reddish mixed with violet, abdomen white.[18] Dorsal shields with whitish centers, lateral shields paler than surrounding skin; viscera blackish.[2] Iris with greenish tint (WLD).

Maximum size: 1353 mm TL,[9] 16.5 kg.[19]

DISTRIBUTION AND ECOLOGY

Range: St. John River, New Brunswick,[3] to St. Johns River, Florida;[2] rare and endangered.[3,10]

Area distribution: Possibly before Delaware[2] and Potomac Rivers,[5] also recorded from Virginia.[4]

Habitat and movements: Adults and juveniles—found most often in tidal rivers,[2] also recorded from open sea some distance from parent stream.[2] In St. John River, New Brunswick migrations to overwintering areas take place in September and October.[19] Overwintering occurs in estuarine lakes at depths exceeding 10 m,[9,19] and deeper regions of the lower estuary in salinities up to 20 ppt and temperatures of 4–8 C. During April move out of overwintering areas and concentrate in river channels. Around mid-June movement to summer feeding areas occurs.[19]

Larvae—on bottom for several days after hatching.[14]

SPAWNING

Location: Middle reaches of large tidal rivers.[1] In the St. John River, New Brunswick, spawning apparently occurs in the upper estuary adjacent to deep, turbulent sections of the river in extremely turbid water.[19]

Season: Females with mature eggs taken from the Hudson River in December (WLD), February[11] and April.[2] Spawning in the St. John River, New Brunswick, takes place between May 15 and June 15[19] and may continue until late August or early September.[9]

Time: During peak flood tide.[19]

Temperature: Average 10 C.[19]

Salinity: Fresh during spawning, possibly becoming brackish with changes in tidal cycles.[19]

Fecundity: 48,000–99,000.[19]

EGGS

Mature ovarian eggs—average diameter 3.0 mm;[19] dark brown in color.[2]

Fertilized eggs—demersal, extremely adhesive just after fertilization, after ca. 2 hours essentially nonadhesive.[2]

Pigmentation: Brown 1/2 circumference, grayish white other 1/2, eye visible 6 days after fertilization, light in color; 8–9 days after fertilization darker, plainly visible.[2]

Incubation: 4–6 days at unspecified temperature;[12] at 7.8–12.2 C, 13 days.[2]

YOLK-SAC LARVAE

Very dark in color,[14] otherwise no information.

LARVAE

No information.

JUVENILES

Specimen described 197 mm FL.[3]

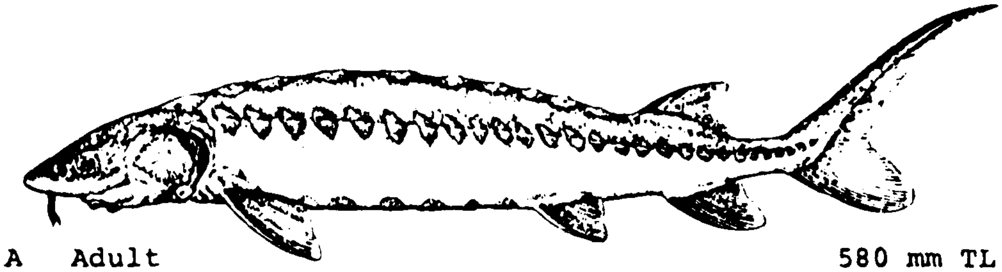

Fig. 3. *Acipenser brevirostrum*. Spawning female 580 mm TL. (*Vladykov, V. D., and J. R. Greeley, 1963: fig. 8.*)

Head 28% of FL, postorbital distance 33% of HL.[2]

Snout longer than postorbital distance. Scutes on 5 main rows sharp, set closely together.[2]

AGE AND SIZE AT MATURITY

In St. John River, New Brunswick, 8.8 ± 1.7 years, but females apparently do not spawn until 15.5 ± 1.4 years, even though mature.[10] (Reports of 4–8 years in both sexes in the Hudson River[7] are based on incorrect aging methods, WLD.) Males may mature at 490 mm,[7] most above 533 mm are mature.[2] Smallest mature female 460 mm, smallest ripe female 700 mm TL.[19]

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APPENDIX D

CULTURAL RESOURCES

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SECTION D-1

GILBERT/COMMONWEALTH

R-1998

CULTURAL RESOURCES OVERVIEW
AND
SENSITIVITY ANALYSIS
FOR THE
DELAWARE RIVER AND BAY

SUBMITTED TO
U.S. DEPARTMENT OF THE ARMY
Philadelphia District
Corps of Engineers
Custom House
2D and Chestnut Streets
Philadelphia, Pennsylvania 19106

PREPARED UNDER THE SUPERVISION OF
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Principal Investigator

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CONTRACT DACW61-78-D-0013
WORK ORDER NO. 0005

February 16, 1979

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INTRODUCTION

In 1978 Gilbert/Commonwealth contracted with the Department of the Army, Philadelphia District, Corps of Engineers to conduct Historical Resources Reconnaissance Services and Investigations in the Philadelphia District Area. Work Order 0005 called for a cultural resources overview and sensitivity analysis of data for shoreline areas bordering Rehoboth Bay and Lewe and Rehoboth Canal in Delaware and Delaware Bay and River from the Atlantic Ocean to Trenton, New Jersey.

The Work Order 0005 cultural resources study is being conducted in conjunction with the Philadelphia District, Corps of Engineers' Delaware River and Bay Dredging Disposal Study. Authorized by the United States Senate Committee on Public Works in October 1974, and initiated in February 1978, the study is intended to develop a regional spoil disposal plan for the tidal portions of the Delaware River, its tidal tributaries, and Delaware Bay. The Delaware River is tidal upstream to Trenton, New Jersey; the tidal tributaries and other project sites have been defined as follows: Neshaminy State Park Harbor, Pennsylvania; Schuylkill River, Pennsylvania, mouth to University Avenue, 6.5 miles; Wilmington Harbor, Christina River, Delaware, 9.9 miles; Smyrna River, Delaware, 9.5 miles; Little River, Delaware, 3 miles; Murderkill River, Delaware, 8.5 miles; Mispillion River, Delaware, mouth to

Milford, approximately 11 miles; Broadkill River, Delaware 10.3 miles; Harbor of Refuge, Delaware; Cooper River, New Jersey, 1.8 miles; Big Timber Creek, New Jersey, 5.5 miles; Mantua Creek, New Jersey, 7 miles; Racoon Creek, New Jersey, 9.8 miles; Salem River, New Jersey, 5 miles; Cohansey River, New Jersey, 19.5 miles; and the Maurice River, New Jersey, 24 miles (COE 1978).

Gilbert/Commonwealth has undertaken Work Order 0005 to provide the following services for the Delaware River and Bay dredging disposal study.

I. Literature and records background search

   a. with attention to archeological sensitivity analysis based upon

      1) environmental factors which have influenced human occupation;

      2) review of regional literature and State Historic Preservation Office archeological site files;

   b. with attention to historic sites based upon

      1) a comprehensive review of State Historic Preservation Office historic site inventories;

      2) preparation of abstracts and locational mapping for protected historic sites.

Literature and records research was conducted in Pennsylvania at the Office of Historic Preservation, Pennsylvania Historical and Museum Commission in Harrisburg between

December 4 and 6, 1978. Commonwealth project archeologist Stephen R. Claggett conferred with Curator of Archeology Barry C. Kent, and Archeologist Ira F. Smith, III. Project historian John R. Kern worked with Curator and Environmental Review Specialist William O. Hickok and Curator and National Register Coordinator Susan M. Zacher. At the advice of Mr. Hickok, Kern subsequently corresponded with Kathryn Ann Auerbach, Historical Programs Coordinator for the Bucks County Conservancy; Richard Tyler, Historian for the Philadelphia Historical Commission; and Martha Wolfe of the Brandywine Conservancy; (Ms. Auerbach reported January 1979 that the Bucks County Conservancy has not yet surveyed the lower part of Bucks County; see Appendix for response from Richard Tyler received February 12, 1979).

Literature and records research was conducted in Trenton, New Jersey at the Office of Historic Preservation, New Jersey Department of Environmental Protection, where Kern worked primarily with Architectural Historian William McCrea; the Office of Environmental Review, New Jersey Department of Environmental Protection where Claggett conferred primarily with Archeologist Olga Chesler; and the New Jersey State Museum where Claggett consulted with State Archeologist Lorrain Williams and Staff Archeologist Karen Flinn. The records and literature search in Trenton, New Jersey was carried out December 6 to 8, and 11, 1978.

Literature and records review was conducted in Delaware at the Department of State, Division of Historical and Cultural Affairs, Bureau of Archeology and Historic Preservation at the Hall of Records in Dover between December 12, and 14, 1978. Claggett and Kern worked with Historical Archeologist Cara L. Wise, and Kern conferred with Historian Dean E. Nelson.

Minor site verification was carried out at Cape May by Claggett and Kern on December 9 and 10, 1978. On December 10, project staff members were accompanied by Robert Logan, President of the Greater Cape May Historical Society. Additional site verification was made at the Island Field Site in Kent County, Delaware by Claggett on December 13 and 14, 1978. On December 13, Claggett was accompanied by Historical Archeologist Cara Wise. No additional on-the-ground archeological investigations were carried out during the reconnaissance.

ENVIRONMENTAL BACKGROUND

Discussion of the environmental factors that have influenced human occupation of the Delaware Bay margins must recognize the time depth involved and the climatic, geologic and hydrologic changes that have occurred. A large body of current research concerns regional questions of natural/cultural interactions or has a direct bearing on investigations of archeological manifestations in the coastal zone (J. Kraft 1977; Kraft and John 1978; Fairbridge 1977; Sirkin 1977; Edwards and Emery 1977; Edwards and Merrill 1977; Thomas et al. 1975; Griffin 1976). Man has occupied the area for at least 10,000 years, and perhaps as much as 40,000 years before present (B.P.) (J. Kraft 1977: 44; Thomas 1974; Mason 1971; H. Kraft 1974; 3-7, 1977). Dramatic fluctuations in climate, sea level and floral/faunal patterns during even the last 5-6,000 years have influenced, and will continue to influence, human settlement along Delaware Bay.

The geomorphic setting of Delaware Bay is that of a drowned river valley or estuary. The present coastal plain and offshore continental shelf are formed of cretaceous and Miocene-Pliocene(?) age sediments, covered in most places with Quaternary age sands, gravels and clays (J. Kraft 1977; Johnson 1950; Widmer 1964). Lowering of world sea levels ca. 40,000 years B.P. resulted in exposure of the continental shelf for a distance of 75-100 km from the present shoreline, coupled with entrenchment of the ancestral Delaware

River and formation of a series of river terraces. Melting of glacial ice masses during the last 10,000 years has reversed the process, resulting in gradual,yet variable, rates of coastal submergence (J. Kraft 1977; Thomas et al. 1975).

Rising ocean levels and resultant encroachment of salt water tolerant species and formation of tidal marshes have placed dynamic strictures on human settlement of the bay margin. Boreal forest communities typified the region during the Pleistocene, but were gradually replaced by deciduous (oak, hickory) climax species during the early Holocene, and black gum and cypress in some areas by 5-6000 B.C. (Whitehead, 1973) coincidental, with coastal submergence and resultant establishment of estuarine plant and animal communities. Fossil pollen samples, wood and peat species and extinct megafaunal remains (mammoth, mastodon, walrus, ground sloth) have been recovered from various onshore and offshore contexts and attest to this long-term series of climatological and floral/faunal changes (J. Kraft 1977; Edwards and Merrill 1977; Sirkin 1977; Kraft and John 1978). Aboriginal exploitation of these changing environments consisted of hunting and gathering of extinct and modern game, forest products and littoral resources (especially fish and shellfish) (H. Kraft 1974; Thomas 1974). Yet, little direct evidence remains of early occupational sites, due to their probable orientation along the drowned river and bay margins.

The gradual shift to modern conditions has been completed only within the last 2-3,000 years (J. Kraft 1977; Thomas et al. 1975; Griffith 1976; Robichand and Buell 1964). Geological and archeological data indicate an essentially modern climate and floral/faunal communities since that time. Prehistoric sites have yielded evidence for exploitation of white-tail deer, elk, black bear, turkey, raccoon, muskrat, various birds and waterfowl, fishes, turtles and several types of shellfish. Plant remains are less common, but sites were evidently situated to maximize access to marsh and upland varieties of nuts, seeds, roots, reeds and "greens" (Thomas et. al. 1975; Griffith 1976; H. Kraft 1974; Cross 1941). Tropical cultigens (maize, beans, squash) were added to this list some time around A.D. 1000, and whaling was practiced by at least the seventeenth century (Dickinson 1972).

In general terms, Delaware Bay microenvironments encompass several interfacing habitats: coastal beaches and dunes; shallow lagoons and tidal marshes; coastal plain uplands; tributary streams; and dissected piedmont uplands. Most of the study area is within the Atlantic Coastal Plain province, with predominantly sandy soils and habitats combining shorelines, lagoons, marshes, tidal estuaries and adjacent uplands. Tidal estuaries and marshes dominate the lower half of the Bay margins, while a relatively flat

floodplain is present along the Delaware up to the fall line (Johnson 1950; Widmer 1966). The upstream portion of the study area includes the Delaware floodplain, low river terraces, uplands and their draining tributary streams, all of which are part of the Piedmont Crystalline Province (J. Kraft 1977). Natural communities have been virtually eliminated along portions of the drainage, particularly as the result of urban and industrial developments during the twentieth century.

ARCHEOLOGICAL BACKGROUND

A review of regional literature and state site files indicates that variable data are available on prehistoric archeological sites along the margins of Delaware Bay. Centralized files in the three states of Delaware, Pennsylvania and New Jersey contain site data based on information derived from sources as variable as recent systematic surveys and amateur collector's reports from the turn of the century. In general, site information from Delaware is rather complete, due to efforts in the last decade to systematically survey coastal and drainage areas throughout the state. The Pennsylvania portion of our study area lacks all but the most rudimentary site data, largely due to heavy urbanization and industrialization of the Philadelphia area. New Jersey files contain site records from selected drainages, largely derived frcm intuitive surveys conducted during the first three decades of this century (Skinner and Schrabisch 1913; Cross 1941).

Comparisons of data from the three-state region are understandably difficult. A general discussion of the prehistoric background of the Bay area can be offered, nevertheless, based in part on published sources from the larger Middle Atlantic Coast region.

The major cultural/historical traditions identified for eastern North America are the Paleo-Indian (15,000-8,000 B.C.), Archaic (8000-1,000 B.C.), Woodland (1,000 B.C.-A.D. 1,000) and Mississippian (A.D. 900-1,500) stages or traditions (Griffin 1967; Dragoo 1976). Evidence exists for only the first three traditions in the Delaware Bay region; Algonquian groups present at the time of white contact were living basically Woodland lifeways and did not participate in the social, religious and political systems that identify Mississippian culture groups (Thomas 1974; H. Kraft 1974; Goddard 1978; Snow 1978).

Paleo-Indian

Paleo-Indian sites in the greater Bay region consist mainly of isolated finds of fluted projectile points, occasionally associated with less diagnostic knives, scrapers or other implements. In keeping with current interpretations, it can be argued that Paleo-Indian settlement/subsistence patterns involved hunting of Pleistocene megafauna and certain northern Holocene forms (caribou, musk ox) and gathering of available plant foods. No evidence exists for direct exploitation of littoral resources. Relative scarcity of sites and artifacts is taken as an indicator of low population density and a nomadic lifestyle, but a general lack of data is attributable to the presumed destruction of many sites by coastal submergence over the last 12,000 years (J. Kraft 1977; H. Kraft 1974, 1977; Edwards and Emery 1977; Mason 1971; Bryan 1977).

Archaic

A similar situation obtains for at least the early portion of the Archaic stage (8000-4000 B.C.). Holocene climate changes resulted in modified biotic patterns as well as rising sea levels. Changes in artifact styles are viewed elsewhere as indicative of a gradual transition from Paleo-Indian to increasingly regionalized Archaic traditions (Adovasio et al. 1977; Morse 1973; Coe 1964; Broyles 1971; Gardner et al. 1977). This transition either did not occur in the Delaware Bay region or has not been recoginzed (Thomas 1964; H. Kraft 1974). Early Archaic sites are known for the upper Delaware and the lack of information from the Bay area again reflects site destruction due to flooding.

Middle and Late Archaic settlement patterns also are poorly understood, but increased populations are inferred and recognizable tool forms reflect participation in extra-regional traditions termed Piedmont Archaic and Laurentian (Thomas 1974; H. Kraft 1974; Kensey et al. 1972).

Archaic settlement/subsistence patterns were predicated on coalescence or dispersal of kin-based groups for exploitation of seasonally available foods or other resources (Caldwell 1958; Kent 1970). It has been argued that this "diffuse" economic pattern reached a level of refinement called Primary Forest Efficiency (Caldwell 1958; Cleland 1976) during the Late Archaic period, but recent

research indicates that highly scheduled and efficient patterns existed during the Early Archaic (Chapman 1977) and continued to function into the historic period (Thomas et al. 1975; Mounier 1974; Griffith 1976; Snow 1978).

Transitional

A transitional phase has been defined for the Middle Atlantic region during the period from 1800-1000 B.C. Increased sedentism is implied, based on more substantial village remains and the presence of soapstone cooking vessels, which would have limited, to some extent, the transhumance patterns typical of earlier Archaic groups. Certain lithic tool forms also are typical of this period, which, as the name implies, is "transitional" between the Late Archaic and early Woodland cultural/historical periods (H. Kraft 1974; Witthoft 1974).

Woodland

Woodland period groups in the Delaware Bay region are identified basically by the use of ceramics and peripheral participation in rather flamboyant Early and Middle Woodland traditions termed Adena and Hopewell elsewhere (Dragoo 1976; Pollak n.d.; DeValinger 1970; Cross 1956). Design elements found on ceramic sherds allow distinctions to be made between localized Woodland groups (Lopez 1961) as well as allowing fairly precise analyses of external relationships (H. Kraft

1974;Cross 1941). Larger populations were concentrated in Woodland villages and increased status differentation is inferred for burial details. Increased sedentism is attributable to the introduction of tropical cultigens, especially maize, some time around A.D. 1000, but Woodland groups continued to participate in seasonal rounds of food-gathering and, possibly, social contacts.

Archeological investigations in the area bordering Delaware Bay historically have concentrated on Woodland period sites, evidently because of their visibility and large size(DeValinger 1970; Thomas and Warren 1970a, 1970b). Amateur and professional attentions have focused on ceramic period sites due to their potentially well-preserved artifact and featural contents of burials, storage pits, hearths, middens and house patterns. As discussed previously, older Paleo-Indian and Archaic sites usually offer a less complete array of specimens, and represent only a small remnant of the possible variations in site size and content. Most analyses of prehistoric life in the Bay region are based on data from large Woodland period sites such as Mispillion, Island Field, Hughes-Willis, Poplar Thicket, Cape Henlopen and Townsend in Delaware. Woodland sites in southeastern Pennsylvania remain undiscovered or are destroyed.

New Jersey sites have not been rigorously explored or reported in the literature, except along the upper Delaware or inland from the river and bay (Snow 1978; H. Kraft 1974; Thomas 1974; Thomas et. al. 1975; Cross 1941; Skinner and Schrabish 1913; Kinsey 1972). Recorded sites in southern New Jersey and southeastern Pennsylvania are either poorly documented or do not otherwise lend themselves to ready cultural/historical identification or processual interpretation (cf. Cook 1960, 1969). Basic Late Archaic and Woodland relationships have been defined, however, at sites in the Maurice River drainage of southern New Jersey (Mounier 1974).

Late Woodland groups occupied large base camps on the central portions of Delaware Bay tributaries but continued to fragment into seasonally smaller units for the seasonal exploitation of various estuarine and upland resources (Thomas et al. 1975; Griffith 1976; Mounier 1974). Maize production was an important part of Late Woodland economics, but never to the extent of late prehistoric (especially Mississippian) groups elsewhere in eastern North America.

Contact

Contact period aboriginal groups inhabiting the Delaware Bay region are identified as Algonquian- speaking

Delaware, or Lenape (Snow 1978; Goddard 1978; Hunter 1974; Weslager 1953; Thomas and Lewis 1966). Some evidence suggests, however, that the Late Woodland Slaughter Creek phase in the lower reaches of the Bay (Lewes-Rehobeth area) was more closely related to historic Algonquian, Nanticokes, Assateague. Choptank and Pocamoke groups of the Chespeake Bay region (Thomas 1974; 17). Townsend series ceramics found on sites in southern Delaware are definiens for the Slaughter Creek phase (Snow 1978; 63; Thomas and Lewis 1966).

Less intensive research has been devoted to late sites in southern New Jersey, but early documents indicate that Lenape groups were historic inhabitants (Cross 1941; Skinner and Schrabish 1913; H. Kraft 1974; Weslager 1972). Sources tend to indicate that the east side of the Bay was more intensely occupied than the west side (Goddard 1978; 215; cf. Johnson 1925). Investigations by Mounier (1974) demonstrate gross similarities between the Late Woodland Fralinger site on the Maurice River and larger Middle Atlantic cultural traditions, but "...social organization and the relationship between archeological cultures and ethnohistorically described groups in this area await elucidation" (Mounier 1974: 54).

Historic

Goddard (1978:214) identifies several historic Delaware groups in the Bay area -- Unami speakers whose settlements were aligned along major stream drainages. The groups and their locations listed by Goddard are as follows: Sewapois (Cohansey River); Little Siconese (Salem River); Naranticonck (Raccoon Creek); Mantaes (Mantua Creek); Armawamex (Big and Little Timber Creeks); Remkokes (Rancocas Creek); Atsayonck (Crosswicks Creek); and Sankhikans (near the falls at Trenton). Settlements or groups mapped for Pennsylvania include Minquannan (White Clay Creek), Quineomessinque (Brandywine Creek), and by the late seventeenth century, Okehocking (Ridley and Crum Creeks) and Playwicky (upper Neshaminy Creek). Rapid depopulation and political disruption of eastern Pennsylvania during this period has been attributed to conflicts with Susquehannocks from further north along the Delaware (Goddard 1978:215).

Southern Unami groups were apparently involved in close trans-Bay contacts; the sole group recorded by Goddard for Delaware (Lewes- Cape Henlopen area) is the Big Siconese, an apparent "tribal variant of the Little Siconese in New Jersey (see above; Goddard 1978; 215). Relationships between the Big Siconese and the Late Woodland Slaughter Creek phase are unclear.

Subsistence/settlement patterns of early historic Delaware groups varied little from precedents established during prehistoric Archaic and Woodland periods. Permanent base camps or villages, usually situated at mid-drainages, were abandoned during winter and summer for satellite camps where activities involved hunting, gathering or fishing. Warfare also has been cited as an impetus for periodic dispersals(Goddard 1978:216-217). These ancient patterns were seriously and rapidly disrupted in the seventeenth century, as trade with the Dutch reoriented the Delaware economy. Settlements were consolidated as the result of land sales,with period group fragmentation for fur-hunting or trading activities. European trade goods and introduced food-stuffs also contributed to disruption of traditional patterns.

Delaware occupation of the Bay region was ended effectively by the late seventeenth century, reflected in a gradual westward movement of local groups into Pennsvlvania. Claims of certain southern Unamis (in New Jersey) ended with their relocation to the Brotherton reservation in 1758. Later history involves various consolidations with Shawnee, Iroquois, Wyandot and other native groups in New York, Ohio, Pennsylvania and,eventually, Oklahoma (Goddard 1978; Weslager 1972).

HISTORIC OVERVIEW

Historic Background

The first Europeans to reach Delaware Bay were explorers who sailed for the Dutch. Henry Hudson put into the Bay in 1609 while under the employ of the Dutch East India Company. In the early 1620s Cornelius Jacobsen May headed a Dutch West India Company colonizing expedition which sailed up the Delaware Bay. Around 1624 several Dutch families established Fort Nassau, now Glocester, New Jersey. In 1631 another group of Dutchmen formed a trading company headed by David Pieterssen deVries. An expedition financed by their company created a settlement near the present town of Lewes, Delaware in 1631, but when deVries reached the outpost in 1632, he found that all its inhabitants had been killed by Indians (Ward 1930; Hawke 1960).

During the 1630s Dutch control of Delaware Bay was contested by the Swedish West India Company. Commanded by Peter Minuit, the first Swedish expedition in 1638 founded Fort Christina, now Wilmington, Delaware. Subsequently headed by Johan Prinz, the Swedish colony expanded during the 1640s to encompass both shores of the Delaware River and Bay from the Schuylkill River to Cape Henlopen on the western shore and from the mouth of Assunpink Creek, now Trenton, to Cape May on the eastern shore (Ward 1930; Billington 1960).

The struggle for control of the region's profitable fur trade became three cornered in the 1640s when a group of New England merchants organized as the Delaware Company and, led by George Lamberton, built a post at the site of Philadelphia. This and a second attempt at settlement were thwarted by both Swedish and Dutch forces (Dunway 1948).

Having eliminated the New Englanders, Dutch and Swedes opposed one another for control of the Delaware. The rivalry focused on the present site of New Castle, Delaware, where in 1651 the Dutch built a post named Fort Casimir. Swedes seized the fort in 1654. But the next year, Dutch troops commanded by Peter Stnyvesant captured all Swedish strongholds and forever ended Sweden's claims to the region (Hawke 1966; Ward 1930). The Dutch immediately consolidated their Delaware Bay holdings by reorganizing the Fort Casimir settlement as New Amstel. Headed by Alexander d'Hinoyossa in 1659, the outpost secured possession of all lands on the west bank of the Delaware and a strip three miles wide along the east bank. During this period the trading post near the present town of Lewes was reestablished (Scharf 1888).

England saw Dutch settlement along the Hudson and the Delaware as a threat to British colonial expansion and an obstacle to enforcement of the newly instituted Navigation Acts. Consequently, in 1664 Charles II, wishing to reward the

commerical classes who had supported his restoration, ordered the capture of all Dutch possessions in America. Four frigates reached New Amsterdam in September 1664 where Struyvesant captivated. Delaware did not fall until the following month when Sir Robert Carr stormed Fort Casinis (Hawke 1966; Billington 1960).

After the British conquest of Dutch possessions in America, Charles II granted those lands to his younger brother, the Duke of York. York in turn presented that portion between the Hudson and Delaware Rivers as the Colony of New Jersey to his friends Lord John Berkeley and Sir George Carteret. In 1674 Berkeley sold his share to two Quakers, John Fenwick and Edward Byllynge. When Fenwick and Byllynge began to feud over their purchase, William Penn was asked to arbitrate the dispute. Penn became a trustee of the lands relinquished by Byllynge, and in 1676 succeeded in obtaining a division of New Jersey whereby Carteret kept East Jersey and the Quakers West Jersey which bordered on the Delaware River and Bay. The Quakers began to govern West Jersey with a progressive consitution drafted by William Penn; Fenwick attempted, however, to develop his land as though it were a separate colony. East Jersey held its own assembly. Political matters were further complicated when the Governor of New York refused to recognize New Jersey's sovereignty. Litigation over land titles continued throughout the colonial period, and differences

between East and West Jersey were unresolved, even after the colony possession from proprietary to royal political control in 1702 (Newberry 1977; Hawkes 1966).

English settlement of West Jersey began during the politically turbulent years of the late seventeenth century. When Edward Byllvnge died in 1687, his right of government passed to the Anglican Dr. Daniel Cox, who apparently built a residence more than four miles north of Cape May Point on the Delaware Bay side near Town Bank (Nash 1968). Cox sold his share of West Jersey in 1692 to a joint stock company of English merchants intent upon the promotion of ship building and whaling. Residents of the southern portion of West Jersey were primarily occupied with cattle grazing and farming during the 1700s, though they occasionally fished, whaled, and provided other boating services as ferrymen and pilots.

Because of its strategic location between New York City and Philadelphia, New Jersey was an important theatre of war during the American Revolution. Washington's victories at Trenton and Princeton during the winter of 1776-77 marked a turning point in America's battle for independence. Statehood was attained in 1787, the same year that New Jersev ratified the constitution (Alden 1954; Newberry 1977).

William Penn relinquished his trusteeship of West Jersey in 1681, the year that he received the charter to Pennsylvania from Charles II in return for debts which the King owned Penn's father. Penn issued a Frame of Government, publicized his colonizing venture in the British Isles and on the Continent, and set sail for his proprietary in 1682. That fall he landed in Upland, now Chester, Pennsylvania and called a general court which passed a declaration of liberty of conscience. Within two years 7,000 Welshman, German Quakers and Irish had emigrated to Pennsylvania. Nearly one third of them settled in Philadelphia, a city designed by Penn with a checkerboard layout so that the "streets may be uniform down to the water "of the Delaware" where it is most navigable." Penn had chosen his capital well; located on a major waterway it prospered, first from the fur trade, and later from agricultural produce which reached it from the rich lands along the Delaware. As early as 1700, Philadelphia rivaled Boston in commerce, and on the eve of the Revolution, Penn's capital had become the second largest city in the British empire (Nash 1968; Hawke 1966).

To protect Pennsylvania's avenue of commerce to the sea, Penn in 1682 received from the Duke of York a grant of land along the western shore of Delaware Bay from the southern boundary of Pennsylvania to Cape Henlopen. These three lower counties, as Delaware was called throughout the colonial era,

were governed as part of Pennsylvania until 1704. At that time, discontent over lack of military protection and lack of responsive representation led to the creation of a separate assembly at New Castle. The Lower Counties profited from the production of tobacco until around 1730 and thereafter from the cultivation of wheat. After fighting in the American Revolution as a separate political entity, Delaware became the first state to ratify tne Constitution (Scharf 1888; Wise 1978). The prosperity of the Delaware River and Bay has continued to expand since the close of the American Revolution. Wilmington became a major center for milling flour in the 1780s after the development of new mill machinerv bv Oliver Evans. The earliest paved roads extended from Philadelphia to Lancaster in 1794. The Du Pont powder mills were established on the Brandvwine south of Wilmington in 1802. The Chesapeake and Delaware Canal was begun in 1803. The Schuylkill Canal linked Philadelphia and Reading in 1825,by which time steam boats had begun to ply the Delaware. A railroad network was begun during the following decades, and the concentration of economic infrastructure has been such that century land use along the Delaware from Trenton to Wilmington has become almost entirely urban (Hoffecker 1976; Taylor 1951; Newberry 1977).

Inventory of Protected Historic Sites

The following inventory has been based upon an extensive examination of the Historic Sites Inventories at the Pennsylvania, Delaware, and New Jersey State Historic Preservation Offices. At each state Preservation Office the Commonwealth project team mapped and prepared an abstracted statement of significance for each National Register status site or district which was located within one mile of the Delaware River and its tidal tributaries as specified in the regional spoil disposal plan. Additional sites were recorded at the suggestion of the respective Preservation Office staffs. The sites recorded were those listed in the National Register of Historic Places and those nominations which have been approved by the State Historic Preservation Review Boards as of December 1978 but whose designation is pending approval by the U.S. Department of the Interior. New Jersey State Register of Historic Places sites have also been recorded because the New Jersey Register law of 1970 protects those sites from publicly funded undertakings; Pennsylvania and Delaware do not have comparable legislation (New Jersey Register n.d.).

In Pennsylvania and Delaware the State Preservation Office site designation numbers were utilized, as were the Inventory site abstracts. The Commonwealth project team arbitrarily assigned site numbers for the New Jersey sites because that state has no mapping system for register properties. The abstracts of significance for all New Jersey

sites were prepared directly from the historic site nomination files; the same procedure was followed in Pennsylvania and Delaware for the more recently designated sites which have not yet been abstracted in their respective Inventories.

The Inventory of Protected Historic Sites presents information on each registered property in the following format:

1. Site Letters and Numbers

   a. the first letter identifies the state in which the site is located

      P = Pennsylvania

      D = Delaware

      N = New Jersey

   b. the second letter identifies the county in which the site is located

      Pennsylvania:

         B = Bucks County

         P = Philadelphia County

         D = Delaware County

      Delaware:

         N = New Castle County

         K = Kent County

         S = Sussex County

      New Jersey

         M = Mercer County

         B = Burlington County

Ca = Camden County

G = Gloucester County

S = Salem County

Cu = Cumberland County

Cy = Cape May County

c. site numbers have been assigned to each within a given county. As stated above, the Pennsylvania and Delaware site numbers are those used in their respective registered site mapping systems; the Commonwealth project team has arbitrarily assigned site numbers to the New Jersey registered properties

2. Site Name

3. Site Address

4. Date of Construction

   a succession of dates indicates times of structural alteration; events of associational significance; or periods of construction for historic districts

5. Abstract of Significance

6. Designation

   a. Nat Reg = listed in National Register of Historic Places

   b. Nat Reg pending = approved by State Historic Preservation Review Board but not yet approved by U.S. Department of Interior

   c. NHL = listed as a National Historic Landmark; all such properties are automatically listed in the National Register of Historic Places

   d. HABS = recorded by the Historic American Buildings Survey

   e. HAER = documented by the Historic American Engineering Record

   f. State Register = listed in the New Jersey Register of Historic Places.

Sites are grouped by state and county and are listed from north to south in order of their location along the Delaware River and Bay and its tidal tributaries. The site letters and numbers are portrayed in the same sequence on the margins of the three maps in Figure 2; Pennsylvania and Delaware sites are placed on the left side map margins, and New Jersey sites are placed on the right side map margins. Actual site locations are also shown by site letters and numbers in Figure 2.

Pennsylvania

Bucks County

PB 20 Delaware Canal

Parallels west bank of Delaware River from Easton to Bristol (1837). Completed in 1837, the 60 mile Delaware Canal ran from Bristol to Easton. It had 23 lift locks and nine aquaducts. The canal served as a major shipping route for the northeastern coal fields. It also comprises a portion of Theodore Roosevelt State Park. NHL.

PB 22 Calhoun Street Bridge

Bridge across the Delaware between Morrisville, Pennsylvania and Trenton, New Jersey (1885). Well preserved "Phoenix Iron Bridge" at Morrisville. Constructed in Phoenixville, Pennsylvania, it is one of the longest bridges of this type extant in the state. Seven spans of 180', constructed of wrought iron rolled in semi-circular sections and riveted together - subsequently known as the Phoenix Column. This column was designed and patented by Wendell Bollman. Nat. Reg., HAER.

PB 11 Summerseat

Clymer Street at Morris Avenue, Morrisville (c. 1770) two and a half story brick, gable roof

Georgian structure, the home of George Clymer, a signer of the Declaration of Independence. Five bays across, two rooms deep with a pent eave. NHL.

PB 10 Pennsbury Manor

South of Bordentown, near USI and 13, Falls Township (1682 and 1939). A one and a half story, brick reconstruction of William Penn's home. This reconstruction, based on Penn's correspondence, was constructed in 1939. Nat. Reg.

PB 01 Andalusia (Nicholas Biddle Estate)

Pa32 1.4 miles north of Philadelphia, Bensalem Township (late eighteenth century). Two and a half story Greek Revival building constructed at site of an earlier structure. Nicholas Biddle politician and financier of the Revolution designed the classical motif and lived here. NHL.

PB 28 St. Elizabeth's Convent (Sisters of the Blessed Scarament)

Bristol Pike, Bensalem Township (late nineteenth century). Designed by Charles Burns in the late nineteenth century, these gray stone, tile roofed buildings were constructed for Katherine Drexel who founded the "Sisters of the Blessed Sacrament for Indians and Colored People." The order has grown and by 1955 had placed teachers in 22 states. Nat. Reg.

Philadelphia County

PP 32 Frankford Arsenal

Tacony and Bridge Streets, Philadelphia (1830). Initiated in 1816 as a munitions depot, the complex originally contained six stone buildings and two small workshops. It has been greatly expanded and still serves as a major center for the development of military weapons. Nat Reg.

PP 63 USS Olympia

Pier 40 at foot of Chestnut Street, Philadelphia (1888). The cruiser Olympia is the oldest steel-hulled American warship afloat. Seved as Commodore George Dewey's flagship in the Battle of Manila Bay during the Spanish American War. NHL.

PP 130 USS Becuna

Perris Landing, Delaware and Spruce, Philadelphia (1944). A World War II fleet submarine commissioned in 1944, served as submarine flagship of the Pacific fleet under command of General Douglas MacArthur. Used by the Navy from 1944 to 1969. Ship is 309 feet long, 27 feet wide with a weight of 1,526 tons. Nat. Reg.

PP 40 Woodlands (William Hamilton House)

40th Street and Woodland Avenue, Philadelphia (c. 1742, 1770). Two and a half story stone, hip

roofed, late Georgian house with round head and Palledian window and a six column portico. The Country house of William Hamilton, son of Andrew Hamilton who defended Peter Zengen William lived there until his death in 1813 and took an active interest in landscaping the grounds. In 1839 the house and 91 acres of land were incorporated into the Woodland's Cemetery; the property still serves this function. NHL; HABS.

PP 75 Society Hill Historical District

Walnut Street to Lombard Street to Delaware River to 8th Street Philadelphia (eighteenth- nineteenth century). The oldest portion of Philadelphia contains more than 575 eighteenth and nineteenth and commercial residential, and religious structures. Most of the early residences are brick with wood trim, and belt courses. Nat. Reg., HABS.

PP 77 Southwark District (Wiaco)

5th Street tc Washington Street to Delaware River to Lombard Street, Philadelphia (eighteenth and nineteenth century). Originally an independent borough called Wicaco by the Swedes who lived there, Southward was the center of Philadelphia maritime activity during the eighteenth century and served as a home for mariners. Houses of brick, two and a half stories high, with gable roofs, chimneys, and dormers. Nat.

PP 38 Gloria Dei Church (Old Swedes Church)

Swanson Street, between Christian and Water Streets, Philadelphia (1698-1700). Gloria Dei was built for the Swedish Lutheran congregation at Wicaco. Philadelphia's oldest church, constructed of brick with a steep roof, several gables, square belfry, and a small spire. Nat. Reg., HABS.

PP 06 John Bartram House and Gardens

54th Street and Elmwood on the Schurylkill River, Philadelphia (1731). Two and a half story stone house built in 1731 by noted botanist John Bartram. Located on 26 acres of land which comprise Bartram's botanical gardens. NHL, HABS.

PP 72 Commandant's Quarters (Quarters "A")

U.S. Naval Base, Philadelphia (1875). Three-story brick building with slate roof, constructed on League Island which was deeded to the United States by the City of Philadelphia in 1868. Quarters A is slated for conversion into a permanent Naval Historical Museum which will depict the development of the U.S. Navy. Nat. Reg.

PP 109 Marine Barracks

U.S. Naval Base, Philadelphia (c. 1900). Located on League Island (see Commandant's Quarters), the first permanent building was constructed in 1901 at a cost of $95,000. Unmodified since its construction, the Barracks is a four story building of red brick and gypsum block construction. Nat. Reg.

PP 30 Ft. Mufflin (Old Fort Mufflin)

Southwest corner of 5th and Chestnut Streets, Philadelphia (pre 1777). Laid out in 1771 by Englishman John Montressor, the fort's completion was interrupted by the American Revolution. Captured by the British the fort was reconstructed of stone in 1798 by Pierre Charles l'Eufaut. NHL, HABS.

PP 31 Ft. Mifflin Hospital (Old Fort Mifflin Hospital)

Marine and Penrose Ferry Roads, Philadelphia (nineteenth century). The hospital was built after the Battle of Fort Mifflin. It served as a hospital and prison for Confederate troops captured during the Civil War. Nat. Reg.,HABS.

Delaware County

PD 37 Old Drain and the Chemistry Building

14th Street between Melrose Avenue and Walnut Street, Chester (1867). Designed by John Crump for a

military institute of 350 cadets; subsequently known as Pennsylvania Military Academy and the Pennsylvania Military College, now known as Widener College. Four and a half story structure of stucco with a stone ground story and gable dormers. Central bay topped by a sixth story pediment. Pending Nat. Reg.

PD 27 Old Main

21st Street and Upland Avenue, Upland (1858). A large three story building with three connected, pedimented pavilions. Begun as a boys school, the building served as a hospital for Union and Confederate wounded during the Civil War. Nat. Reg.

PD 17 Chester Courthouse

Market Street below 5th Street, Chester (1724-44). A two and a half story building with a small square cupola. A three-sided bay addition with large windows was added in 1744. One of the oldest public buildings in the nation. Nat. Reg.

PD 19 Penn Landing Site

Penn and Front Streets, Chester (1682). A granite stone with inscriptions which marks the spot where William Penn landed, October 1682. Nat. Reg.

PD 21 Printzhof

Taylor Avenue and 2nd Street, Essington (c. 1643). Site of earliest permanent European settlement in Pennsylvania. Excavations of the Swedish settlement of New Gothenburg have uncovered foundations of Governor Johan Printz, house as well as numerous artifacts. NHL.

PD 11 Lazaretto

Wanamaker Avenue at 2nd Street, Essington (nineteenth century). Three-story, hipped roof, Georgian structure with cupola and long flanking wings. Built as a quarantine station for sick immigrants; served as hospital until 1880. Nat. Reg.

PD 28 Crozer Manison

6th Street, Upland (1867). Large two-story stone house designed in Italinate Style with three-story tower and elaborate interiors; the home of a wealthy textile manufacturing family. Nat. Reg.

PD 22 Pusey House

15 Race Street and Landingford Plantation, Upland (1683, 1696) Originally a one and a half story gambrel roof stone house with one ground floor room. A gable roof extension was constructed C.1696. One of the earliest English built houses in America. Nat. Reg.; HABS.

PD 30 Pusey-Crozier Mill Historical District

Race Street, Upland (seventeenth - nineteenth century). A district along Chester Creek which encompasses the Pusey House and a three-story, plastered stone textile mill. Nat. Reg.

Delaware

New Castle County

DN 450 Robinson House (Naaman's)

Naaman's Corner, Claymont (c. 1770). An additive residence consisting of a frame and masonry portion and a stone wing to the rear constructed by General Thomas Robinson, aide to Anthony Wayne during the Revolutionary War. Nat. Reg.; HABS.

DN 157 Mendenhall House

205 East Front Street, Wilmington (c. 1780). A large residence built prior to 1790 by Thomas Mendenhall who sailed in the Caribbean and to the British Isles. He prospered by this trade and served as an assistant burgess in 1795 and a commissioner of the Levy Court in 1801 and 1818. Nat. Reg., HABS.

DN 874 Friends Meeting House

4th and West Streets, Wilmington (1817). Built in 1817 on the site of an 1748 meeting house, the

present structure remains in religious ownership and in its cemetery are buried Governors John Dickinson, and Caleb Prew Bennett, abolitionist Thomas Garrett, and journalist Hezekiah Niles. Nat. Reg.

DN 340 Holy Trinity (Old Swedes) Church

Between Church Street, 7th Street, and Church Lane, Wilmington (1699). A stone church with brick trim begun in 1698 and dedicated in 1699. Built by the Swedish Lutherans at the site of a burial place in use since 1638, repaired in 1842, and restored in 1898, this is thought to be one of America's oldest churches which is still used for services. NHL; HABS.

DN 388 Fort Christina

Foot of 7th Street, Wilmington (1638). Site of the landing of a Swedish expedition commanded by Peter Minuit. The Swedes established their settlement in 1638, and built a fort which they called Christina in honor of the Queen of Sweden. This became the first permanent settlement in the Delaware River Valley. NHL.

DN 174 Old Ashbury Methodist Church

3rd and Walnut Streets, Wilimington (1789). Thirty-five feet square when completed in 1789, the church has since undergone extensive alterations. Nat. Reg.; HABS.

DN 051 St. Mary's Church

6th and Pine Streets, Wilmington (1858). A brick church constructed in 1858, the only catholic church in Delaware erected during the espicopate of Bishop John H. Neumann. The central tower was added in 1881. Nat. Reg.

DN 3637 Harland and Hollingsworth Office Building

Foot of West Street, Wilmington (c. 1900). A three-story brick flemish bond structure built in Georgian Revival style for one of the oldest and most important shipbuilding companies in the country. Pending Nat. Reg.

DN 4018 "State of Pennsylvania"

Partially submerged Christiana River at foot of Madison Street, Wilmington (1923). A ship 219' long, 49' beam, 10 1/2' draft; built in 1923, modified 1944; one of the largest single screw river steamers; foundered in 1970. Pending Nat. Reg.

DN 1423 Woodstock

102 Middleboro Road, Wilmington (eighteenth Century). The only remaining plantation property along the Christina River. Owned by Swede Andries Andriessen in the mid seventeenth century, the land passed into the hands of John Richardson in 1687; Richardson's son, John II, leved there after 1704 and built a home at the present site of Woodstock. Nat. Reg.

DN 246 Hale-Byrnes House

Corner DE 7 and 4, Stanton vicinity (1750). A structure whose brick wing dates from 1750 and was built for Samuel Hale, a potter; Daniel Byrnes, a miller, added the north wing after his purchase of the property in 1772. In 1772 General George Washington held a council of war in the house. Nat Reg.; HABS.

DN 403 Swanwyck

65 Landers Lane, Swanwyck (c. 1850). An excellent example of Regency architecture designed prior to the Civil War by Peter Bandy who also prepared the plans for Wilmington's Town Hall. Nat. Reg., HABS.

DN 386 Glebe House

Del #9, near New Castle (c. 1825). A brick house built in three sections and occupied by the rector of Immanuel Church. Nat. Reg.; HABS.

DN 399 The Hermitage

Del. #273, near New Castle (1801-1818). Built between 1801 and 1818 by Nicholas Van Dyke who served in the Delaware House of Representatives and in the U.S. Senate. Nat. Reg.;HABS.

DN 362 Stonum

9th and Washington Streets, New Castle (1730, 1750. Built in 1730 and 1750, this house was owned by George Read I, a signer of the Declaration of Independence, and Kensey Johns, Chief Justice of Delaware. NHL; HABS.

DN 1475 Christina Historic District

Junction of DE 7 and 273 (1760s-1820s). Located at the head of navigation on the Christina River and on the main highway between Philadelphia and Baltimore, Christina prospered during the Revolutionary Era. The village became an important grain shipping port and contained 36 structures by 1816. The town's economic decline began with completion of Chesapeake and Delaware Canal in 1829. Nat. Reg.

DN 385 Lesley-Travers Mansion

112 West 6th Street, New Castle (1855). A brick house with pine structural members; designed in Gothic style by Baltimore architects Thomas and James Dixon for Dr. Allen Voorhees Lesley. Nat. Reg.

DN 1290 Old New Castle Court House

Delaware Avenue at the Green, New Castle (1732, 1765, 1845). Built in four sections, the central part was completed in 1732; two wings were added in 1765; one of these was replaced in 1845, and the entire structure was restored in the 1950's. The structure housed the Delaware General Assembly until 1777, and the Declaration of Independence was approved there in 1776. NHL; HABS.

DN 349 New Castle Historic District

The Strand, Delaware Avenue, 3rd Avenue, Harmony Street, New Castle (1651-nineteenth century). Founded by the Dutch in 1651, New Castle was Delaware's first town, the meeting place of all colonial assemblies and the first state capital. NHL; HABS.

DN 1306 Amstel House

4th and Delaware Streets, New Castle (1730). The present structure, built for Dr. John Finney, around 1730, probably incorporates portion of an earlier structure. The house was subsequently occupied in the eighteenth century by Delaware Governor Nicholas Van Dyke. Nat. Reg.; HABS.

DN 219 Buena Vista

U.S. #13, south of Wilmington (1845-1847). A five-bay, two-story brick structure with six Doric columns and cast iron balustrade, built c. 1845 in the Greek Revivial style for John M. Clayton, U.S. Senator and Secretary of State under President Zackary Taylor. Nat. Reg.; HABS.

DN 145 Fort Delaware

On Pea Patch Island in Delaware River, Delaware City vicinity (c. 1850). A pre-Civil Ware five-sided fort with walls of solid granite 7 to 30 feet thick surrounded by a moat 30 feet wide. Nat. Reg.; HABS.

DN 1559 Eastern Lock of the Chesapeake and Delaware Canal

Buttery Park, Delaware City (c. 1829). The stone walled lock provided access for ships between the river and the canal, near the lock is an iron diving bell used to make repairs on the lock gates. Nat. Reg.

DN 144 Sutton House

Broad and Delaware Streets, St. Georges (1792, 1815). A brick townhouse built for John Sutton, one of St. George's earliest residents and for many years her only merchant. Nat. Reg.

DN 3935 Biddle House

East of U.S. 13, 2 miles south of C and D Canal (c. 1790-c. 1850). Begun as a late nineteenth century one room dwelling of sawn plank; early nineteenth century federal two-story, three bay expansion; additions in mid-nineteenth century with later Victorian wings. The resident of two intermarried farm families, the Vandergrifts and Biddles. Nat. Reg. pending.

DN 3932 Ashton Historic District

Approximately 1 mile north of Port Penn (c. 1750). A complex comprised of three mid-eighteenth century residences of Georgian style; the structures were associated with Robert Ashton who was a significant figure in the early development of New Castle County. Nat. Reg.

DN 1623 Liston Range Rear Light Station

One half mile east of U.S. 13; approximately 2 miles south of C and D Canal (c. 1880). A light station with all appurtenances. Built of wrought iron, this light tower has been in continuous use since the last quarter of the nineteenth century. Nat. Reg.; HAER.

DN 3928 Port Penn Historic District

Port Penn (c. 1850). Port Penn was a center for Delaware's peach industry which prospered during the nineteenth century. The district contains approximately 75 properties, most of which are well preserved nineteenth century residences. Nat. Reg. pending.

DN 147 Dilworth House

Port Penn (c. 1680; eighteenth century, late nineteenth century). A three-Bay wide west section

built in brick after 1679 when property was conveyed to Olla Jansen; three-bay east portion of brick added during eighteenth century; frame section added late in the nineteenth century. Nat. Reg.

DN 148 Hazel Glen

Approximately 2 miles east of Port Penn (1845). House with narrow main block, one room deep, designed in Italianate style with Greek Revival details. Nat. Reg.

DN 150 Augustine Beach Hotel

Port Penn vicinity, south on DE 9 (1814). Built in 1814, and named for Augustine Herrman, this hotel catered to vacationers who arrived via steamboat from Wilmington. Nat. Reg.

DN 424 Macdonough House

McDonough and U.S. 13 (c. 1800). The home of Commodore Thomas Macdonough who defeated the British on Lake Champlain during the War of 1812. Nat. Reg. pending.

DN 154 Old Drawyers Church

U.S. Route 13, Odessa (c. 1770). A Presbyterian Church built around 1770 and renowned as an outstanding example of Georgian ecclesiastical

architecture; one of several rural Delaware churches preserved after their congregations built town churches during the mid-nineteenth century. Nat. Reg.;HABS.

DN 416 Appoquinimink Friends Meeting House

Main Street Odessa (1785). A small religious structure used by the Society of Friends from its construction in 1785 until around 1881; since 1951 the meeting house has been used by a group of local friends. Nat. Reg., HABS.

DN 126 Odessa Historic District

Appoguinimink Creek, High Street, 4th Street, Main Street, Odessa (eighteenth and nineteenth century). The district contains well preserved eighteenth century houses and nineteenth century commercial buildings. Nat. Reg.

DN 125 Corbit-Sharp House

Main Street, Odessa (1772-4). A five-bay, two-story brick dwelling with hipped roof and unusual cornice, built in 1772-74 by Robert May for William Corbit, a Tanner Georgian Style. Nat. Reg.,HABS.

DN 152 Hart House

East of Taylors Bridge on DE 453 (1725). A simple three-bay house of brick laid in Flemish bond; the structure was looted by Spanish forces during the War of Jenkins' Ear, 1739-1742. Nat. Reg.

DN 151 Liston House

East of Taylors Bridge on DE 453 (1739). A gambrel roof brick house located near the water's edge on Thoroughfare Neck. Like the Hart House,it was plundered during the 1740s. Nat. Reg.

DN 419 Hugenot House

Del #9 Taylor's Bridge (c. 1730). Originally a three-bay, side-hall brick dwelling, another bay and a smaller brick and frame wing were added after the initial construction. House still in possession of descendants from original owner Elias Naudain. Nat. Reg., HABS.

DN 423 Old Union Methodist Church

North of Blackbird Crossroads on U.S. 13 (1847). An unornamented brick church built in 1847 by a congregation which had worshipped there since 1789. Nat. Reg.

Kent County

DK 133 Sutton House

Woodland Beach vicinity, DE 79 (eighteenth century). A two-story three-bay, hall and parlor house whose eighteenth century interior detail has been well preserved. Nat. Reg.

DK 101 Allee House

Dutch Neck crossroads vicinity off Del. 9. (c. 1765). A two-story, three-bay center hall, brick structure typical of rural Delaware architecture for the period. Nat. Reg.

DK 131 Ruth Mansion House

Main Street, Leipsic (c. 1780). A five-bay two-story, brick house of Flemish bond, the home of William Ruth who served as one of the trustees for the Kent County free school established by the 1796 charity school law. Nat. Reg.; HABS.

DK 132 Snowland

Leipsic DE 42 (Late eighteenth century). Originally a three-bay two-story brick house, later enlarged to five bays with an asymmetrical facade. The home of Andrew Naudain whose son, Arnold was a major in the War of 1812, Dover postmaster, Delaware and U. S. Senator, and twice president of the Delaware Medical Society. Nat. Reg.; HABS.

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DK 136 Wheel of Fortune

DE 9 South of Leipsic (Late eighteenth century). A center hall plan house, one room deep, constructed of brick with a Flemish bond facade which is spanned by a box cornice with molded trim. Nat. Reg.; HABS.

DK 114 Octagonal Schoolhouse

Del #9, south of Cowgill's Corner (c. 1830). An octagonal stone structure built soon after passage of the first free school law in Delaware in 1829. Nat. Reg., HABS.

DK 321 Macomb Farm

South side of Long Point Road, Dover (late eighteenth century). A brick two-story structure with a glazed header Flemish bond facade. Built by Judge Thomas Irons whose son occupied the house and farmed its land until his death in the nineteenth century. Nat. Reg.

DK 130 Old Stone Tavern

Main Street, Little Creek (c. 1825). Built of unusual materials for a county devoid of native stone, the structure was reportedly designed by Manlove Hayes, Sr; interior details reflect the influence of Asher Benjamin. Nat. Reg.

DK 149 Tyn Head Court

East of Dover on South Little Creek Road (eighteenth century). A three-bay, gambrel roof structure owned by James Sykes, a delegate to the Continental Congress, and a member of the Delaware Constitutional Convention of 1792. Nat Reg.

DK 862 Cherbourg Round Barn

West of Little River, South of DE 8 (1918). Unique to Delaware, a round barn with wooden timbering and a poured concrete foundation and walls. Nat. Reg. pending.

DK 108 Dickinson Mansion

Kitt Hummock Road (1740). A two-story bind mansion with main section completed in 1740; the childhood home of John Dickinson who presided over the Annapolis Convention which called for the Federal Constitutional Convention. Nat. Reg. HABS.

DK 117 Town Point (Kingston-Upon-Hull)

Kitts Hummock Road Dover vicinity (c. 1675). A two-story residence with brick ground story and frame upper story. Originally a one-story structure, the Flemish bond edifice was the dwelling of Edward

Pack. Sometime after 1687 Pack sold the house to William Darvall; both men were magistrates, and in this structure were held the first courts for what would become Kent County. Nat. Reg.

DK 113 Lowber House

East of Main Street, US113A, Magnolia (1774). A two-story brick, hall and parlor structure built in 1774 with later frame wings. The brick work features a Flemish bond facade and ornamental brick lintels. Nat. Reg.

DK 137 Reed House

U.S. 113 and DE 8, Little Heaven (1771, 1868). Originally a three-bay, two-story house featuring Flemish bond brick work, built in 1771; enlarged in 1868 to its present five-bay, three dimensions by John Reed who was among the earliest Kent County farmers to introduce budded peach trees. Nat. Reg.

DK 121 Barratt Hall

East of U.S. 113, Frederica vicinity (c. 1750). A brick farm house constructed in the mid-eighteenth century, the home of Philip Barratt where in 1784 Bishops Coke and Asbury met with 11 ministers to plan the separate establishment of the Methodist Episcopal Church. Nat. Reg.

DK 103 Barratt's Chapel

North of Frederica on U.S. 113 (1780). A large brick meeting place which housed gatherings that led to the establishment of the Methodist Church as a separate denomination in America. HABS; Nat. Reg.

DK 123 Bonwell House

North of Frederica on DE 380 (late eighteenth century). A two story, hall and parlor, brick house with a dentil cornice and stone lintel blocks. Nat. Reg.

DK 322 Frederica Historic District

Market, Front and Davids Streets, Frederica (eighteenth-nineteenth century). A district with 121 residential and commercial structures dating from the mid-eighteenth to late nineteenth century. Frederica began as a crossroads settlement and a small shipping center for southern Kent County. Nat. Reg.

DK 129 Mordington

South of Frederica on Canterbury Road (c. 1790). A two story brick dwelling with side hall plan, built in late Georgian style for Walter Douglas, ironmaster and miller. Nat. Reg.; HABS.

DK 360 Wilkerson and Son Brick works

Approximately one mile East of Milford (c. 1900). An early twentieth century brick works in use until 1950; virtually all phases of this industrial operation are still intact. Nat. Reg.; HAER.

DK 244 Christ Church

3rd and Church Streets, Milford (1791, 1835, 1863, 1894). Begun in 1791, completed in 1835, altered in 1863 and 1894 to its present Gothic appearance. Nat. Reg.

DK 167 Bank House

119 North Walnut Street, Milford (1850). Converted from a bank building to a private residence, this brick structure survives as an example of Greek Revival architecture. Nat. Reg.

DK 116 Thorne Mansion

501 Northwest Front Street, Milford (mid- eighteenth century) a two-story brick dwelling with 1 1/2 story wings connected by covered walkways, the home of Sydenham Thorne, an Anglican minister and co-founder of Milford, A. William Burton, Governor of Delaware and John M. Clayton, Secretary of State under President Zachary Taylor. Nat. Reg.

Wise, Cara L.
1978 Early Historic settlement in Delaware, paper presented at the 1978 Middle Atlantic Archeological Conference.

October 1978 Settlement patterns and cultural resource management in the Delaware Experience, paper delivered at the Council on Northeast Archeology, Bear Mountain, New York.

Witthoft, John
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Woolman, H.C.; T. F. Rose; and T. T. Price
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DK 171 Golden Mine

Southeast of Houston, West of Milford (c. 1763). A three-bay, two door frame structure with cypress shingles built on land held by a succession of land companies. Nat. Reg.

Sussex County

DS 177 Abbott's Mill

West of Milford (1860s). Constructed of wood with iron turbines and shafts; one of Delaware's water powered grist mills. Nat. Reg.

DS 186 Delaware Breakwaters and Lewes Harbor

East of Lewes at Cape Herrlopen (1828-1835). The first breakwater of Brandywine granite was designed by William Strickland and constructed between 1828 and 1835. The breakwater forms a harbor of refuge where many ships have taken shelter from storms. Nat. Reg.; HAER.

DS 160 Russell Farmhouse

410 Pilot Town Road, Lewes (c. 1803). A three-bay, 1 1/2 story frame house built around 1803 for Wm. Russell, a tanner and large land holder. Nat. Reg.

DS 174 DeVries Palisade

Pilottown Road, Lewes (1631). The site of a Dutch stockade built in 1631 to protect a trading expedition backed by Captain David DeVries. When DeVries visited the colony in 1632 he discovered that the settlers had been killed by Indians. Nat. Reg.

DS 175 Maull House

Pilottown Road, Lewes (c. 1750). A gambrel roofed two-story, cypress shingled dwelling built around 1750; the house has recently been restored by the local DAR chapter. Nat. Reg.; HABS.

DS 140 Fisher's Paradise

624 Pilottown Road, Lewes (c. 1790). A three-bay, 2 1/2 story house built shortly after the Revolution by Major Henry Fisher who defended Cape Henlopen and the entrance to the Delaware Bay.

DS 314 Pagan Creek Dike

Pagan Creek near New Road, Lewes (seventeenth century). Abandoned since the eighteenth century, the dike was built by Dutch settlers to connect the West Indian Company fort with areas beyond Pagan Creek. The 700 foot long causeway, 9 to 10 feet wide, has changed little since its construction prior to 1670. Nat. Reg.; HAER.

DS 190 Hazzard House

Union Street, Milton (1790). A late eighteenth century hall and parlor house of frame construction built by John Hazzard, a son of Coard Hazzard who settled in the Broadkill Hundred in 1700. John's son, David, was a grain merchant who served as Governor of Delaware, 1830-3. Nat. Reg.

DS 139 Hall House

107 King's Highway, Lewes (1790). A three-bay, 2 1/2 story dwelling with cypress shingles built in 1790 by David Hall, a colonel in the Revolution and later Governor of Delaware. Nat. Reg.; HABS.

DS 142 Coleman House

422 King's Highway, Lewes (c.1780). A 2 1/2 story frame and cypress shingled residence erected around 1780 and characteristic of Sussex County's oldest surviving domestic architecture. Nat. Reg.; HABS.

DS 290 Lewes Historic District

Lewes (Late seventeenth-nineteenth century). The district contains the town plan laid out before 1680 but is presently distinguished primarily for its well preserved Victorian residences. Nat. Reg.; HAER.

DS 145 Lewes Presbyterian Church

King's Highway, Lewes (1832, 1887). A frame edifice topped by a spire, the church was completed in 1832 and remodeled in 1887. It is on the site of one of lower Delaware's first Presbyterian churches, erected in 1707. In its churchyard cemetery are buried two nineteenth century Delaware governors. Nat. Reg.

DS 291 Governor Ponder House

416 Federal Street, Milton (1871-1875). A five-bay, three-story frame and clapboard house with a slate covered Mansard roof built 1871-75 by James Ponder during his term as Governor of Delaware. Nat. Reg.

DS 292 Draper-Adkins House

204 Federal Street, Milton (c. 1840). A 2 1/2 story five-bay frame and clapboard residence built circa 1840 in the Greek Revival style for Captain Joseph Adkins who engaged in Delaware's maritime trade. Nat. Reg.

DS 137 Fisher House

Near Cool Spring (c. 1720). A frame dwelling built between 1700 and 1736 on a tract owned by

Thomas Fisher; Thomas' son Joshua, a merchant, sold the house and land to James Martin in 1736. Nat. Reg.; HABS.

DS 155 Marsh House

10 Dood's Lane, Rehoboth Beach (1742). A two-story frame dwelling with cypress shingles built by yeoman Peter Marsh in 1742. Nat. Reg.; HABS.

DS 152 St. George's Chapel

Chapel Branch North of Hollymount (1794). A brick church erected in Georgian style as an Episcopalian house of worship; extensively restored. Nat. Reg.

New Jersey

Mercer County

NM 01 Mansion House (McCall House)

Cadwalader Park, Trenton (1846). A two-story Itlianate Villa with a three-story tower, built of brick and covered with stucco scored to resemble stone. Originally the home of Henry McCall, a wealthy Philadelphia merchant with Trenton business interests. Nat. Reg.

NM 02 Dickinson House (Hermitage)

46 Colonial Avenue, Trenton (1784). A large two-story house with low hipped roof and stone walls covered with stucco, built in 1784 as the home of Philemon Dickinson, Commander of the New Jersey Militia during the Revolution.

NM 03 Trenton Battle Monument

Warren and Broad Streets, Trenton (1894). A 150 foot granite column topped by a statue carved by R. O. Donovan. Erected between 1891 and 1893, the monument commemorates Washington's triumph at the Battle of Trenton. Nat. Reg.

NM 04 Trenton City Hall

309 East State Street, Trenton (1907). A three-story structure faced with white Vermont marble, designed by Spencer Roberts; the building features a second floor mural painted by Everett Shinn, one of the five original "Ashcan School" painters. Nat. Reg.

NM 05 Old Barracks

South Willow Street, Trenton (1758). Erected in 1758-1759, Hessian troops were quartered in the 2-1/2 story U-plan stone structure when Washington captured the 1000-man garrison in the first battle of Trenton. NHL.

NM 06 State House Historic District

State and Willow Streets, Trenton (nineteenth century). District consists of late Federal clapboard

houses, Greek Revival and later nineteenth century row houses and the State House, begun in 1792, with additions in 1848, 1889, 1891, 1902, 1906. Nat. Reg.; HABS.

NM 07 Mercer Street Friends Center

151 Mercer Street, Trenton (1858). A three-bay 1-1/2 story structure with gable and chimneys, built of brick in 1858 as a meeting house for the Society of Friends Nat. Reg.

NM 08 Mill Hill Historic District

East Front Street, Clay Street, Greenwood Street, S. Broad Street and Jackson Street, Trenton (nineteenth century). A mixture of nineteenth century commercial and residential buildings and open parkland. Nat. Reg.

NM 09 Douglass House (Bright House)

Front and Montgomery Streets, Trenton (1766). A 2-1/2 story frame building with beaded siding where General Washington held a council of war prior to the second Battle of Trenton; moved. Nat. Reg.

NM 10 Trent House

539 South Warren Street, Trenton (1719). A five-bay, two-story brick residence with a central main facade entrance and a central cupola; constructed in 1719 for William Trent who became Chief Justice of New Jersey. The house subsequently served as the residence for several state governors. NHL.

NM 11 Eagle Tavern

431-3 South Broad Street and Ferry, Trenton (c. 1765, 1817). 2-1/2 story brick structure with gable roof dormers, probably first served as residence for manager of nearby grist mills; by 1817 recorded as the Eagle Hotel. Trenton's oldest commercial structure. Nat. Reg.

NM 12 Abbott Farm Archeological Site and Historic District

South of Trenton, north of Bordentown. A large archeological site where Charles Conrad Abbott, M.D. in 1872 reported finding man-made implements in the Trenton glacial gravels on his farm. Dr. Abbott's report initiated a major controversy over the existence of glacial man in the New World which continued for 40 years. NHL.

NM 13 Bow Hill (DeKlyn House)

Jeremiah Avenue off Labor Street, Trenton (eighteenth century). A five-bay, 2 1/2 story, brick residence of Federal style, built in 1790 by the deKlyn family. Barnt deKlyn was a French Hugenot merchant who made a fortune during the Revolutionary War. Nat. Reg.

NM 14 Watson, Issac House

151 Westcott Avenue, Hamilton Township (c. 1710). A two story stone house with steeply pitched roof, small window openings and pent eaves; built around 1710 by Isaac Watson, a farmer, surveyor, constable, and Overseer of Highways. The house features a heavy bowed timer A-frame construction. Nat. Reg.

NM 15 Abbot-DeCore Mansion

58 Soloff Drive, Trenton Vicinity (1797). A two-story, five-bay, brick residence of Georgian design, built by Samuel Abbott and purchased in 1888 by the DeCou family. Nat. Reg.

Burlington County

NB 01 Point Breeze Historic District

Route 206 and Park Street, Bordentown (nineteenth century). A 165-acre estate which contains the site of Joseph Bonapart mansion built in 1817, and an extant two-story three-bay hip roofed house, and a large Italianate mansion constructed in 1850. Nat. Reg.

NB 02 Hopkinson, Francis House

101 Farnsworth Avenue, Bordentown (1750). A two and a half story L-plan brick residence built

in 1750 for merchant John Imlay and subsequently the residence of Francis Hopkinson, lawyer, judge, poet and signer of the Declaration of Independence. NHL, HABS.

NB 03 Bordentown Historic District

Portions of 2nd and 3rd Streets, Bordentown (1800-1900). A mixed residential and commercial district which encompasses much of the town and includes buildings dating from the late eighteenth century to the present. State Register.

NB 04 Roebling Historic District

Riverside and Hornberger Avenues 2nd and 8th Streets, Roebling (1905). A residential and commercial district contiguous to the Roebling Steel Mill and wire rope factory. Roebling was founded in 1904 and built the following year. Nat. Reg.

NB 05 Quaker School

York and Penn Streets, Burlington (c. 1792). A 1-1/2 story brick structure built to house the Society of Friends school whose first classes were recorded in 1705. Nat. Reg.

NB 06 Burlington Historic District

West Delaware, Wood, and Broad Streets, Burlington (seventeenth-nineteenth century). The district contains residential, religious and educational buildings, two of late seventeenth century-early eighteenth century construction. Most structures date from the late eighteenth through the nineteenth century. Nat. Reg.; HABS.

NB 07 St. Mary's Episcopal Church

West Broad and Wood Streets, Burlington (1846). Designed by Richard Upjohn, in Gothic style. Constructed of stone, cruciform in plan with a tower and spire, begun in 1846 and completed in 1854. Nat. Reg.; HABS.

NB 08 Pearson-How, Cooper, Lawrence Houses

453-9 High Street, Burlington (eighteenth century). These well preserved residences are examples of eighteenth century two-story, gable roofed structures whose long, main facades front on Lawrence Street. Their colonial residents were members of the General Assembly; judges and lawyers. James Fenimore Cooper was born in one of these houses in 1789. Nat. Reg.; HABS.

NB 09 Coopertown Meetinghouse

Cooper Street at Route 130, Edgewater Park (1806). A one-story, three-bay structure of brick on a fieldstone foundation, used as a meeting house by Methodists, Episcopalians, Baptists, Friends and Mormons. Nat. Reg.

NB 10 Philadelphia Watch Case Company Building

Pavillion and Lafavette Avenues, Riverside (1852, 1907). A large three-story hotel constructed in 1852, and a seven story trapezordol office structure completed in 1907. The buildings are associated with what was once the world's largest watch case factory. Nat. Reg.

Camden County

NCa 01 Cooper House

7th Street in Pyne Point Park, Camden (eighteenth century). A one and a half story structure of sandstone constructed around 1700; adjoined to a 2-1/2 story brick structure built c. 1785. Known as Cooper's Ferry, the structures remained in Cooper family possession until 1825. Nat. Reg.; HABS.

NCa 02 Taylor House and Office

305 Cooper Street, Camden (1885). A 3-1/2 story stone and brick residence with arched entrance, elaborate bay and Flemish Renaissance gable, designed by Wilson Eyre, Jr. of Philadelphia for Dr. Henry Genet Taylor. Nat. Reg.; HABS.

NCa 03 Newton Friends Meeting House

722 Cooper Street, Camden (1824, 1885). A one-story frame structure on limestone footings built in 1824 and enlarged in 1885 to house the Friends Meeting founded in Camden in 1679. Nat. Reg.; HABS.

NCa 04 Whitman, Walt Historic District

Hinckle Street, 3rd and 4th Avenues, Camden (nineteenth century). This district contains 15 two-three story row houses, including a residence occupied by Walt Whitman from 1884 until 1892. Nat. Reg.; HABS; NHL.

NCa 05 Fairview Historic District

Hill and Olympia Roads, Mt. Eaphrim Avenue, Cresent Boulevard and North-South Freeway Camden (1917). Designed by Alexis Litchfield, the district contains 1000 residences, stores, offices, a library, church, and school, built during WWI to house workers at the Emergency Fleet Corporation shipyard. Nat. Reg.

Gloucester County

NG 01 Red Bank Battlefield

East bank of Delaware River and west end of Hessian Avenue National Park (1777). Fort Mercer, built by the Continentals in 1777, kept the British fleet from supplying the city of Philadelphia which they had occupied in September 1777. In October 1777 British and Hessians attacked the fort but were repulsed with heavy losses. The fort was abandoned in November 1777. One 2-12 story brick structure within the park dates from 1748. HABS; NHL.

NG 02 Whitall House

100 Grove Avenue, National Park (1766). A 2-1/2 story brick house with paired gable end chimneys built by James Whitall, Jr., a prominent Friend. Nat. Reg.; HABS.

NG 03 Fort Billings

Riverfront at Third Street Paulsboro (1777). Site of Revolutionary era fortification; exact location in some doubt. State Register.

NG 04 Vanleer Cabin

South side of US. 322, 2.5 miles west of Swedesboro (c. 1760). A squared log outbuilding with dovetailing, line motar chinking and wood shingles; twice moved. State Register.

NG 05 Stratton House

King's Highway, Swedesboro vicinity (1791-1794). A brick five-bay 2-1/2 story residence with gable dormers and paired gable end chimneys built c. 1794 by Dr. James Stratton. Born here, Charles Stratton, son of James, was first governor to be elected directly by the people of New Jersey. Nat. Reg.; HABS.

NG 06 Trinity Church

Church Street and Kings Highway, Swedesboro (1786, 1838). A red brick structure with two courses of round arched, multi-paned windows, designed and built by Swedish Lutheran minister Reverand Nicholas Collin in 1784; two years thereafter the church was deeded to the Episcopal Church. Nat. Reg.; HABS.

Salem County

NS 01 Finn's Point Rear Range Light

Fort Mott and Lighthouse Roads, Pennsville (1876). A wrought iron, riveted tower 100' high, formerly topped by light apparatus, erected in 1876-7 by the Kellogg Bridge Company of Buffalo N.Y. for the U.S. Lighthouse Establishment; in use until c. 1930 when the lenses were removed. Nat. Reg.; HAER.

NS 02 Fort Mott and Finns Point National Cemetery Historic District

Fort Mott, Pennsville (c. 1865). A 146 acre state park, the site of an early coastal defense built to protect the mouth of the Delaware River. The fort was used as a prison for Confederate soliders; more than 2000 died there and were interred at the Finns Point National Cemetery. Nat. Reg.

NS 03 Market Street Historic District

9-119 Market Street and East Broadway, Salem (eighteenth-nineteenth century). The district contains a preponderance of 2-1/2 and 3 story brick houses built in a variety of architectural styles. Market Street served as the headquarters of both colonial and post-Revolutionary governing bodies for the city and county. Nat. Reg.; HABS.

NS 04 Nicholson House

Amwellbury Road near Featherbed Land Elsinboro Township (1752). A 2-1/2 story, two level brick home with a recent one-story addition; the house was built in 1752 by Samuel Nicholson, son and grandson of two of the earliest settlers in Salem County. Nat. Reg.

NS 05 Homeland (Holme House)

Fort Elfsborg-Hancock's Bridge Road, Elsinboro Township (1784). A two and a half story brick, three-bay-by-two-bay residence; built in 1784 to replace a structure burned in a British raid. Benjamin Holmes, owner of the 1784 house had been a member of the Committee of Correspondence, legislator and member of the Salem County militia. Nat. Reg; HABS.

NS 06 Hancock House

Handcocke Bridge (1734). A two and a half story brick structure with gable dormers built around 1734. The house was the site of a British raid in 1778 in which several Patriots were killed. Nat. Reg.; HABS.

Cumberland County

NCu 01 Giles House

143 West Broad Street, Bridgeton (1791). A 2-1/2 story T-plan frame and clapboard structure with hip roof; built in 1791 for General James Giles who had served as a military officer during the American Revolution. Nat. Reg.; HABS.

NCu 02 Broad Street Presbyterian Church

Broad and Lawrence Streets, Bridgeton (1792). A brick structure with gable roof, 3 bays on the gable ends and five bays on the main long facades; built in 1792 on land deeded to the Presbyterians by Mark Miller. Nat. Reg; HABS.

NCu 03 Potter's Tavern

49-51 Broad Street, Bridgeton (eighteenth century) A two and a half story frame and clapboard structure on a stone foundation built *c.* 1775, a popular hotel because of its proximity to the Cumberland County Courthouse. Nat. Reg.

NCu 04 Seeley House

274 East Commerce Street, Bridgeton (c. 1799-1815). A two-story, three-bay brick structure with a gable end chimney; built in 1799 by S. W. Seeley and altered in 1815 by Robert McGee. Nat. Reg; HABS.

NCu 05 Buck House

297 East Commerce Street, Bridgeton (1808). A two and a half story Federal style structure of brick; built by Jeremiah Buck, the owner of a grist mill and sawmill; subsequently owned by the Elmer Family whose members were active in local politics for fifty years. Nat. Reg.

NCu 06 Maskell House

Bacon's Neck Road, Greenwich vicinity (1698, 1725). A colonial farm residence with a two-story gable roof; frame portion built c. 1698; two-story flemish bond brick addition built c. 1725. The Maskels held local executive office; one was county sheriff; they were active Patriots during the Revolution. Nat. Reg.; HABS.

NCu 07 Greenwich Historic District

Main Street, Greenwich (eighteenth to nineteenth century). Approximately 20 houses, stores, and places of worship constructed primarily during the eighteenth and nineteenth centuries; one of the last changed colonial towns on the eastern seaboard. Nat. Reg.; HABS.

NCu 08 Millville's First Bank

Second and East Main Streets, Millville (1857). A two-story Italianate structure built in 1857 to house Millville's first bank. Refurbished in 1883, the building served as the Millville Public Library from 1908 to 1963. State Register.

NCu 09 Old Stone Church

Fairton-Cedarville and Sayres Neck Roads, Fairfield Township (1780). A one story stone structure with two courses of rectangular 12 over 12 windows, gable roof; built in 1780 by the founding fathers of the Presbyterian Society. Nat. Reg.; HABS.

Cape May County

NCy 01 Dennisville Historic District

Dennisonville (nineteenth century) The district contains a number of additive homes, a township hall, and a church--all of frame construction. The structures range in date from the mid-eighteenth century to the 1890's, with the majority falling in the era between 1800 and 1850. State Register.

NCy 02 Cape May Lighthouse

Cape May Point (1859). The brick lighthouse is 175' high and can be seen for 19 miles. The third Cape May Point lighthouse, this structure was built in 1859. Nat. Reg.

NCy 03 Cape May Historic District

Cape May City (c 1850-1910). Cape May historic district contains one of America's largest assemblages of late nineteenth century frame buildings. It encompasses over 600 summer houses, Victorian hotels and commercial structures. NHL; HABS.

CONCLUSIONS

Archeological Sensitivity

Development of an archeological sensitivity model for the margins of Delaware Bay was a central task of this study. Basic research toward that end involved examination of state site files, perusal of relevant literature and consultation with professional and amateur archeologists -- all of which was directed toward ascertaining the location, nature and expected variability in prehistoric archeological sites in the region. Exact site locations, where known, were not recorded and will not be presented here, at the request of the state officials charged with maintaining site data confidentiality. Instead, a generalized graphic presentation is offered which takes into consideration the variability (and, by the same token, predictive strength) inherent in the archeological data base of each state.

A summary of current archeological knowledge for the Bay region has been presented in another report section. Central to modern archeological research is a recognition of the interrelatedness of cultural and natural systems, particularly in pre-agricultural periods. Recent investigations in coastal Delaware and New Jersey have involved reconstruction of paleoenvironments and emphasize the influence different micro-environmental factors had on the location, size, content and economic orientation of prehistoric sites. Most intensive research has centered on Woodland or

later period sites; the reasons for this and the lack of data on Archaic and Paleo-Indian sites have been discussed elsewhere. A general settlement system can be hypothesized, however, that should characterize most prehistoric periods. Aboriginal inhabitants of the coastal and riverine environments of Delaware, New Jersey and Pennsylvania engaged in seasonal exploitation of certain key resources, scheduling group movements to coincide with availability of those items and with other factors such as weather conditions. Optimal location of permanent and transient camps involved considerations of distance to resources, available storage technologies, carrying capacity of the exploited micro-environments and, possibly, external socio-political restaints on group movement within larger geographic territories. This basic Eastern Woodlands economic pattern of scheduled seasonality has been discussed in some detail by Caldwell (1958), Cleland (1976) and others.

A fairly detailed analysis of those factors which effected prehistoric settlement in the Bay area has been presented by Thomas et al. (1975). Additional comment and corroborative evidence also has been provided by Griffith (1976), J. Kraft (1977) and Kraft and John (1978). The basic settlement model is based on information gained through analysis of site placement in relation to key resources like white-tail deer, nuts, shellfish, anadromous

fish, waterfowl, potable water and less obvious factors like soil type. Recovery of floral and faunal remains from archeological contexts, comparative data from other sites in eastern North America, analyses of tool forms and ethnographic data are presented as evidence for utilization of those resources.

Five distinct settlement patterns are offered as explanatory models for differential site distributions in the Delaware coastal and estuarine zone. Each involves various combinations of base, transient and seasonal camps oriented in fairly linear patterns or within drainage, as opposed to across-drainage,bases. Sites are identified as to size, cultural/temporal components and season(s) of occupancy (based on recovery of season-specific floral and faunal remains). With minor variations, the postulated models involve larger base camps at mid or upper portions of tributary streams and smaller, seasonably-occupied extractive sites on headwaters and near coastal marshes.

Examination of detailed site location maps at the Island Field Museum indicates that recorded sites tend to cluster within drainages on a tri-partite basis of upper,middle and lower drainage. Similar patterns obtain from site data available at the New Jersey State Museum, although specific models as proposed by Thomas et. al. have been tested only on a

casual basis for the eastern shore of Delaware Bay. Mounier's (1974) excavations in the Maurice River drainage appear to confirm the existence of analogous site patternings for New Jersey. Data from Pennsylvania are lacking, but identical economic patterns are not expected to obtain for the geographical portions of our study area where resources like shellfish and resource areas like coastal marshes are absent. As previously discussed, many of the archeological sites once present in the Philadelphia environs have probably been destroyed or obscured by urban and industrial expansion.

A series of site density overlay maps has been produced by staff members of the New Jersey State Museum in connection with a study of the Passaic River basin (Williams et al. 1978). The maps are based on available, non-systematic survey data and indicate that the highest density of sites for our study area occurs in the vicinity of towns like Millville, Bridgeton, Salem, Camden and Trenton -- sites of historic population concentration here increased land clearing and subsequent collector activity have led to disproportionate site discovery rates. Lower site densities calculated for the remaining portions of New Jersey along the Bay are attributable to lack of knowledge rather than actual absence of archeological sites, a fact recognized by the researchers (Williams et al. 1978:71).

Site files and maps of the Island Field Museum, New Jersey State Museum and William Penn Memorial Museum indicate that approximately 420 prehistoric archeological sites have been recorded for the coastal areas and mid and lower reaches of tributary streams along Delaware Bay. Temporal constraints prevented a systematic breakdown of those sites by cultural-historical period, size, land form or soil type, but a general series of notes was made concerning relative site densities and distributions. Literature reviews and interviews with state officials indicate that the majority of temporally identifiable sites are assignable to the Woodland period. Archaic and older sites are underrepresented in the records, or at least have not been recognized. As many as 50 percent of the sites in any one drainage lack cultural/temporal identification, although additional research conceivably could reduce that figure by a substantial margin.

Figures 1A, 1B and 1C of this report indicate our appraisal of relative site densities and potential archeological sensitivity for areas along Delaware Bay. Zones of high, medium and low sensitivity are depicted, based on our research in the various state offices and on a projection of systematically derived data from certain areas to the larger Bay region. The sensitivity zones are based on actual and <u>expected</u> site occurrences. Lack of systematic

archeological surveys in the Bay area and a resultant incomplete data base cannot be emphasized too strongly. Any areas selected as dredge spoil dumping sites will require intensive archeological survey to determine the possible location and nature of cultural resources at each site. Evaluation of project impacts on each identified cultural resource should follow, with recommendations for mitigation of adverse impacts. Site significance analysis should be predicated, minimally, on criteria established by the Advisory Council on Historic Preservation, as embodied in the National Register of Historic Places.

High, medium and low sensitivity zones all contain archeological sites. Areas of the greatest sensitivity are known to have concentrations of prehistoric sites and should be completely avoided. Future construction or dumping activities that involve these areas should be coordinated with monitoring by a professional archeologist, in addition to preliminary surveys and evaluations. Medium sensitivity zones contain relatively fewer sites, or are expected to contain fewer significant sites than the areas of high sensitivity. They include landforms and drainage patterns that did not lend themselves to prehistoric settlement, as currently understood, a situation that is magnified for the low sensitivity zones. Sites do exist in this third zone, but are of low archeological visibility and will only

infrequently be encountered. Marshes typify the low sensitivity area; sites located in and around marshes, according to current models, are expected to be seasonal extractive camps which lack complex stratigraphy or substantial material remains. Low archeological sensitivity can also be projected for many areas of modern urban and industrial expansion. Our research constraints and mapping scales permit only gross definition of such areas.

To summarize,our limited research allows certain subjective statements to be made concerning prehistoric site density and distributions in the Delaware Bay region. Based on data available through published and unpublished sources, the following statements can be offered:

1. Prehistoric archeological sites occur on certain landforms, including stream terraces and elevations within and bordering marshes.

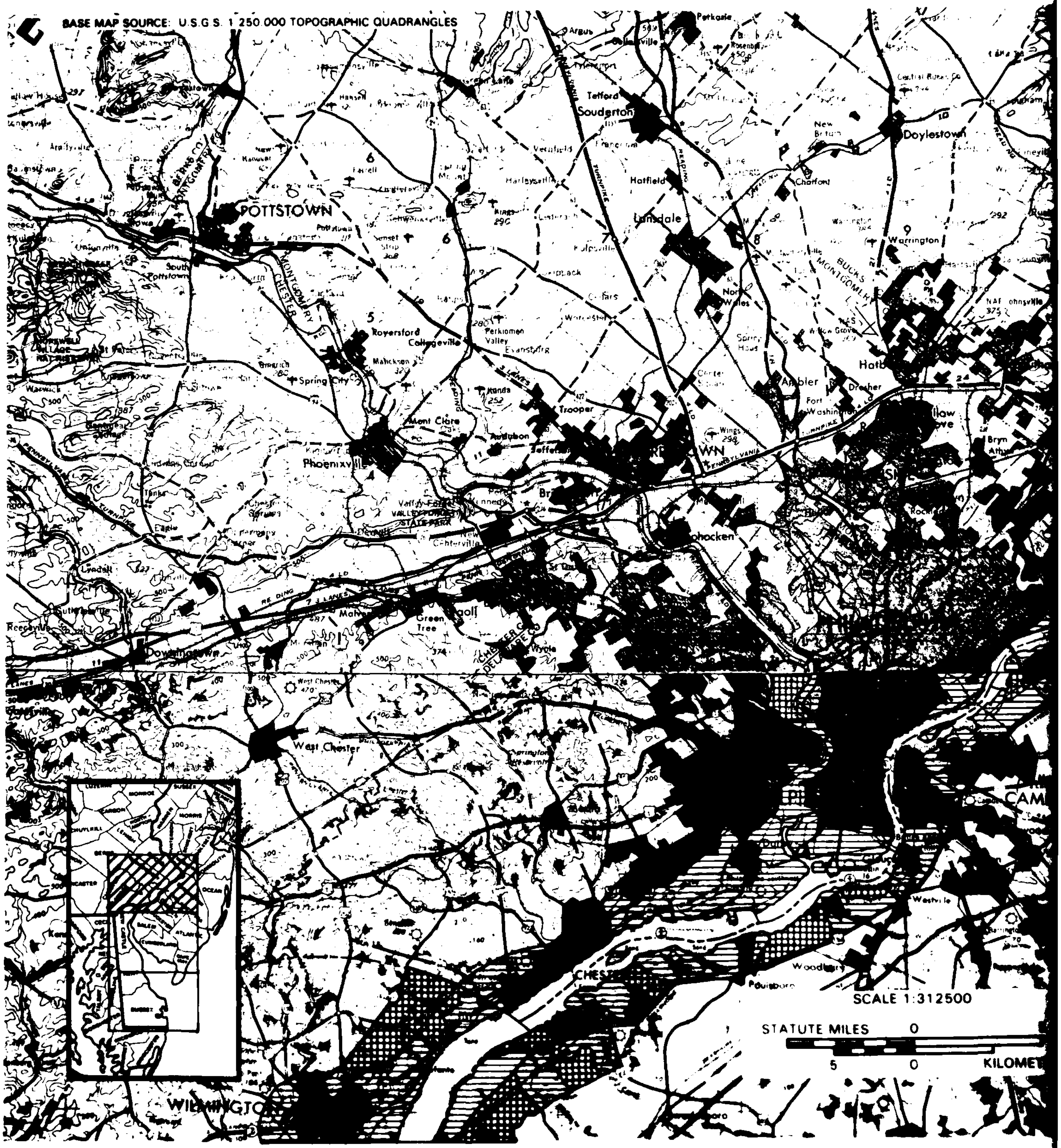
2. Sites are situated along streams, especaiIly near confluences. Freshwater and brackish streams served both as resource procurement loci and transportation routes.

3. In a manner similar to statements 2 and 3 above, sites are located in and near the extensive marshes typical of the Bay, primarily for reasons of resource availability.

4. Prehistoric sites tend to concentrate near modern population centers. Land clearing for construction and agriculture has exposed sites, increasing the likelihood of their discovery by amateur and professional archeologists. Modern settlements also tend to be situated in proximity to streams and critical resources which also were attractants for prehistoric peoples.

Historic Sites

A review of the Inventory of Protected Sites presented earlier indicates that as of December 1978 the Delaware River and Bay Dredging Disposal study area contains 162 historic sites and districts which have been officially determined to possess cultural significance. A total of 157 of these sites and districts have been listed in, or judged eligible for listing in, the National Register of Historic Places. Section 106 of the National Historic Preservation Act of 1966 requires federal review of any federally funded undertaking which might have an adverse effect upon any property listed in the National Register. The New Jersey Register Law of 1970 requires similar review of publicly funded projects which might encroach upon or destroy any property listed in the New Jersey Register. Therefore, it is strongly recommended that the Philadelphia District COE Regional Spoil Disposal Plan avoid negative impact upon the 162 historic sites and districts which have been inventoried and mapped in this report.


BASE MAP SOURCE: U.S.G.S. 1:250,000 TOPOGRAPHIC QUADRANGLES
POTTSTOWN
Souderton
Telford
Doylestown
Hatfield
Lansdale
Chalfont
Warrington
Royersford
Collegeville
Spring City
Phoenixville
Mont Clare
Audubon
Trooper
Ambler
Downingtown
West Chester
Green Tree
SCALE 1:312500
STATUTE MILES
KILOMET

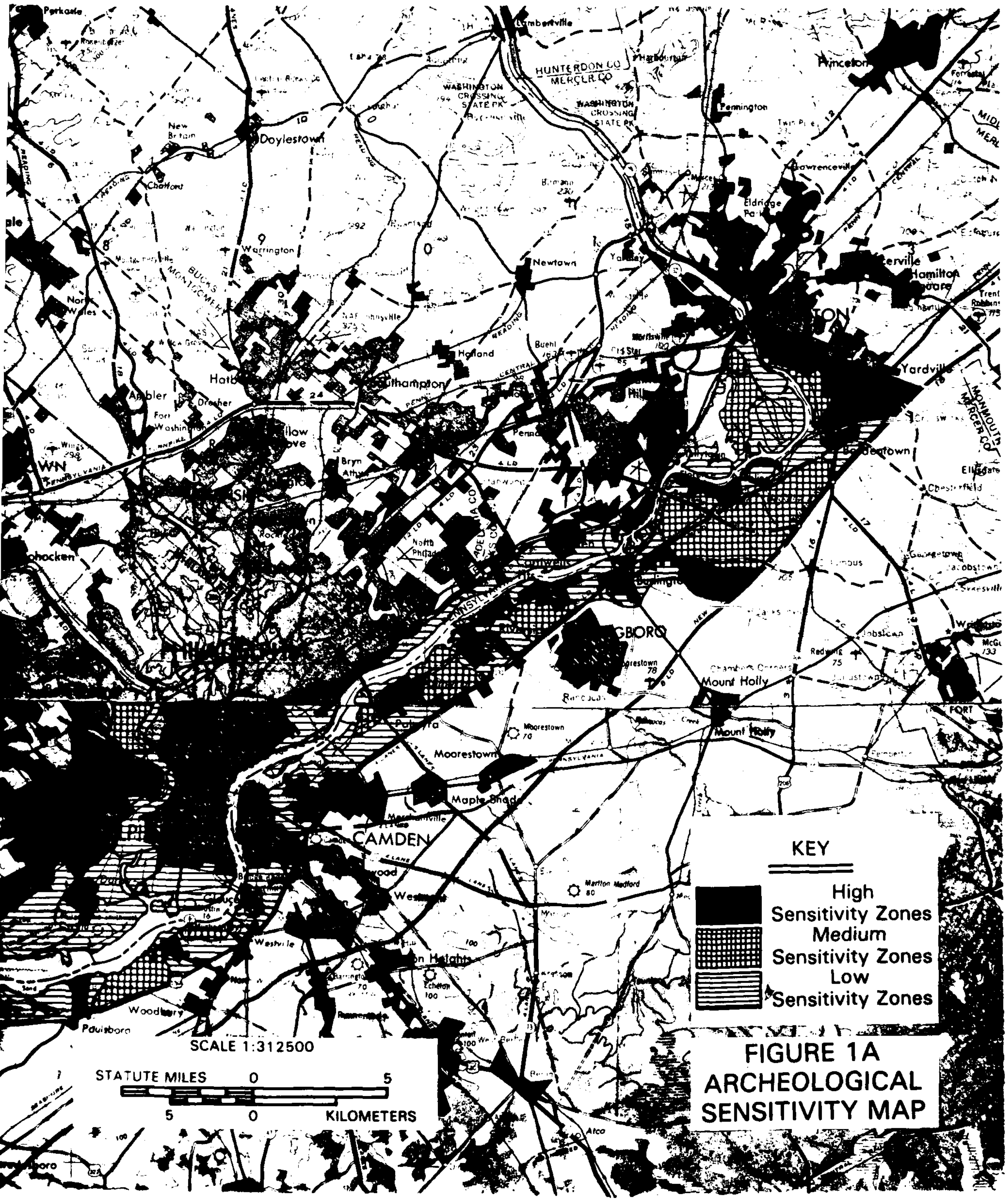
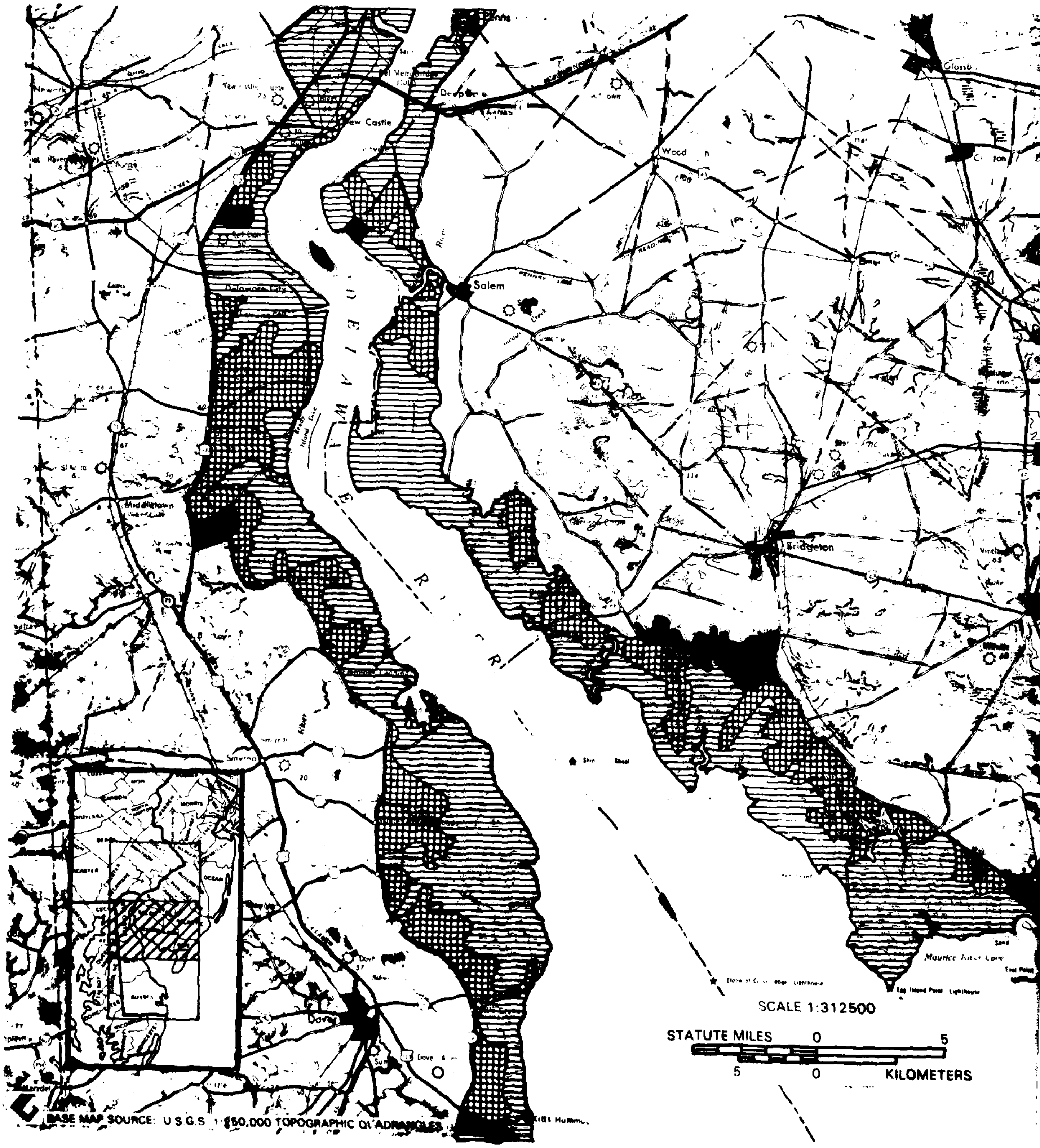


FIGURE 1A
ARCHEOLOGICAL SENSITIVITY MAP


Salem
Bridgeton
Middletown
New Castle
Maurice River Cove
SCALE 1:312500
STATUTE MILES 0 5
5 0 KILOMETERS
BASE MAP SOURCE: U.S.G.S. 1:250,000 TOPOGRAPHIC QUADRANGLES

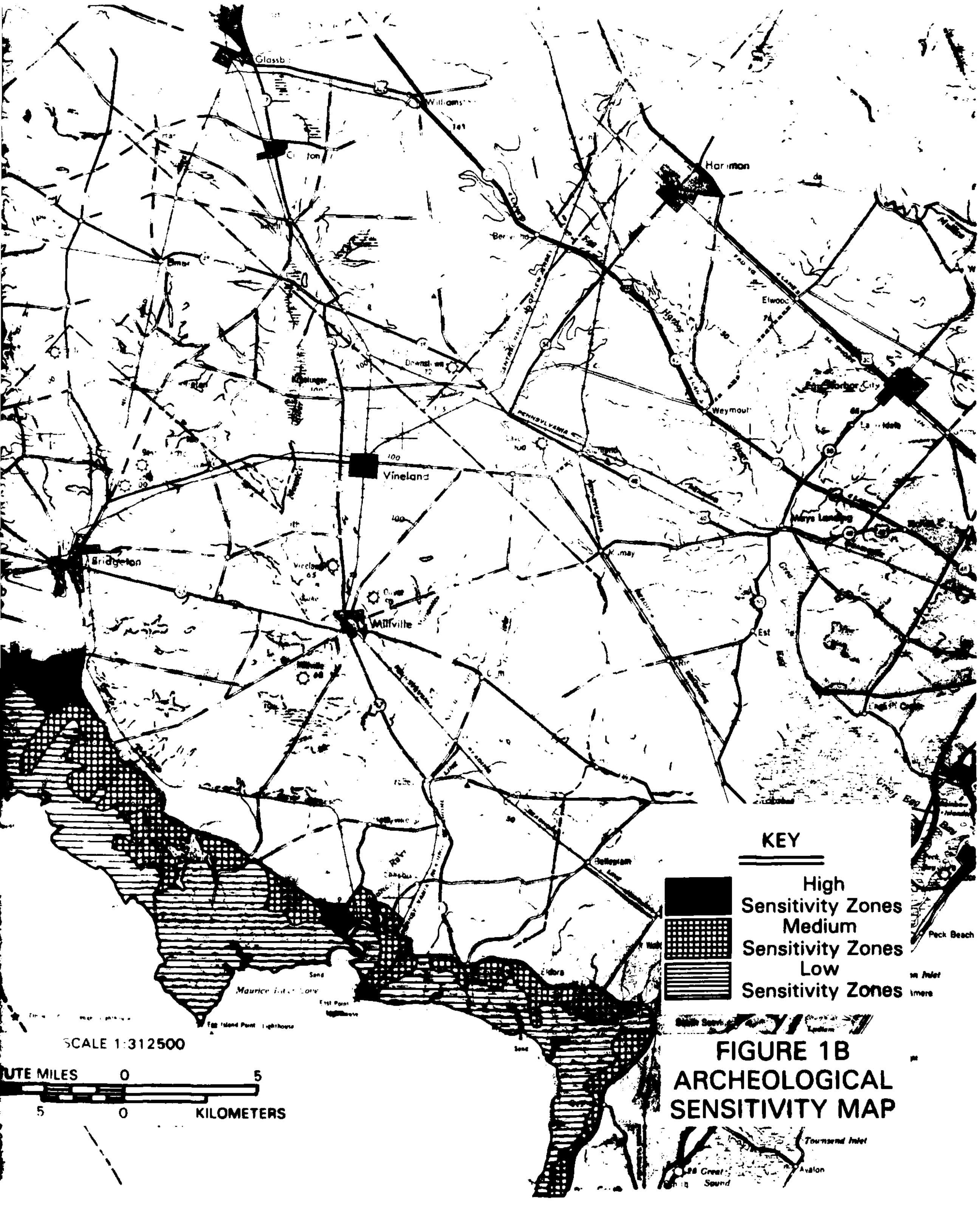
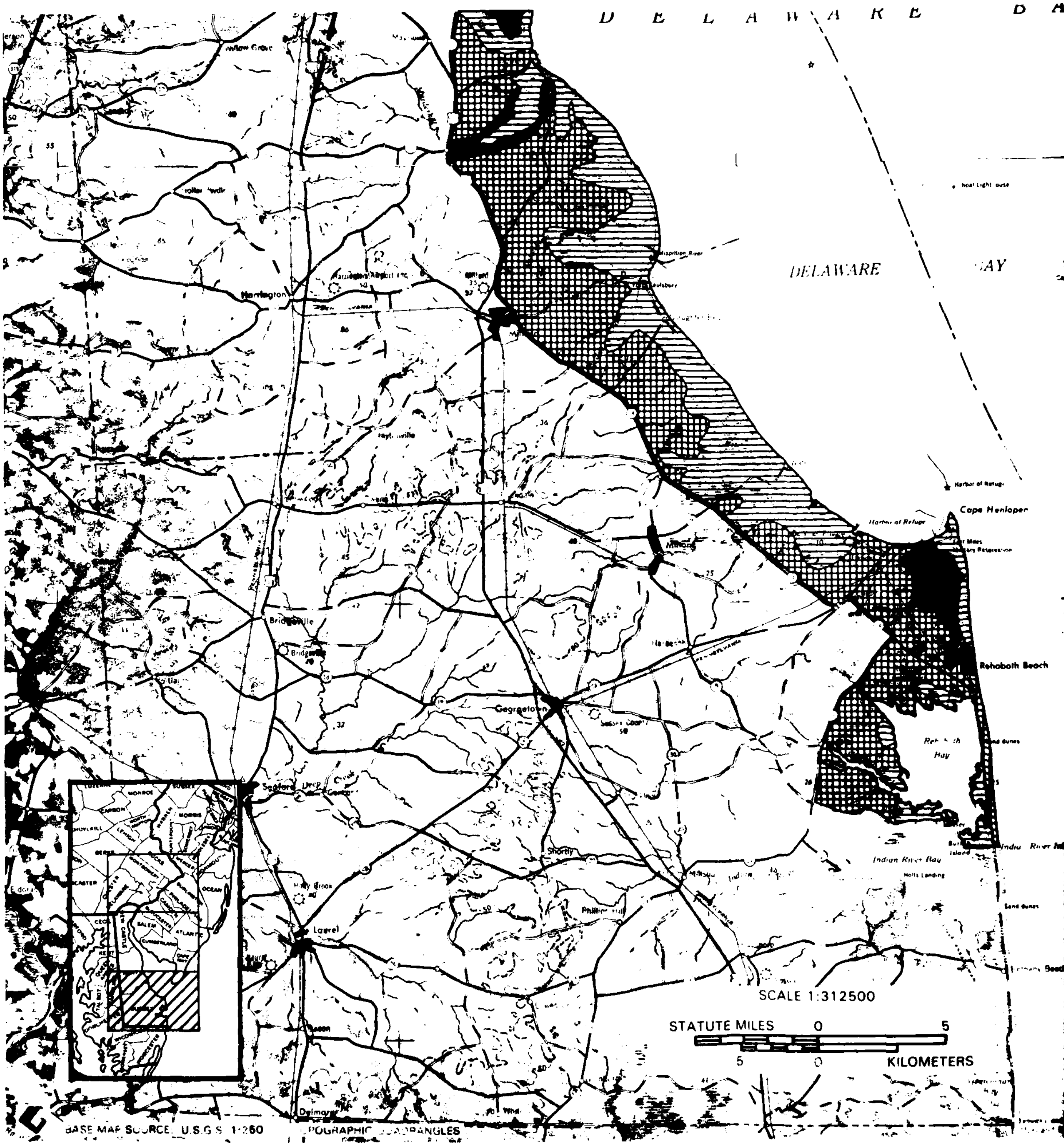


FIGURE 1B
ARCHEOLOGICAL SENSITIVITY MAP



D E L A W A R E B A
DELAWARE BAY
Harrington
Milford
Cape Henlopen
Rehoboth Beach
Bridgeville
Georgetown
Seaford
Laurel
Millsboro
Indian River Bay
Delmar
SCALE 1:312500
STATUTE MILES 0 5
5 0 KILOMETERS
BASE MAP SOURCE: U.S.G.S. 1:250 TOPOGRAPHIC QUADRANGLES

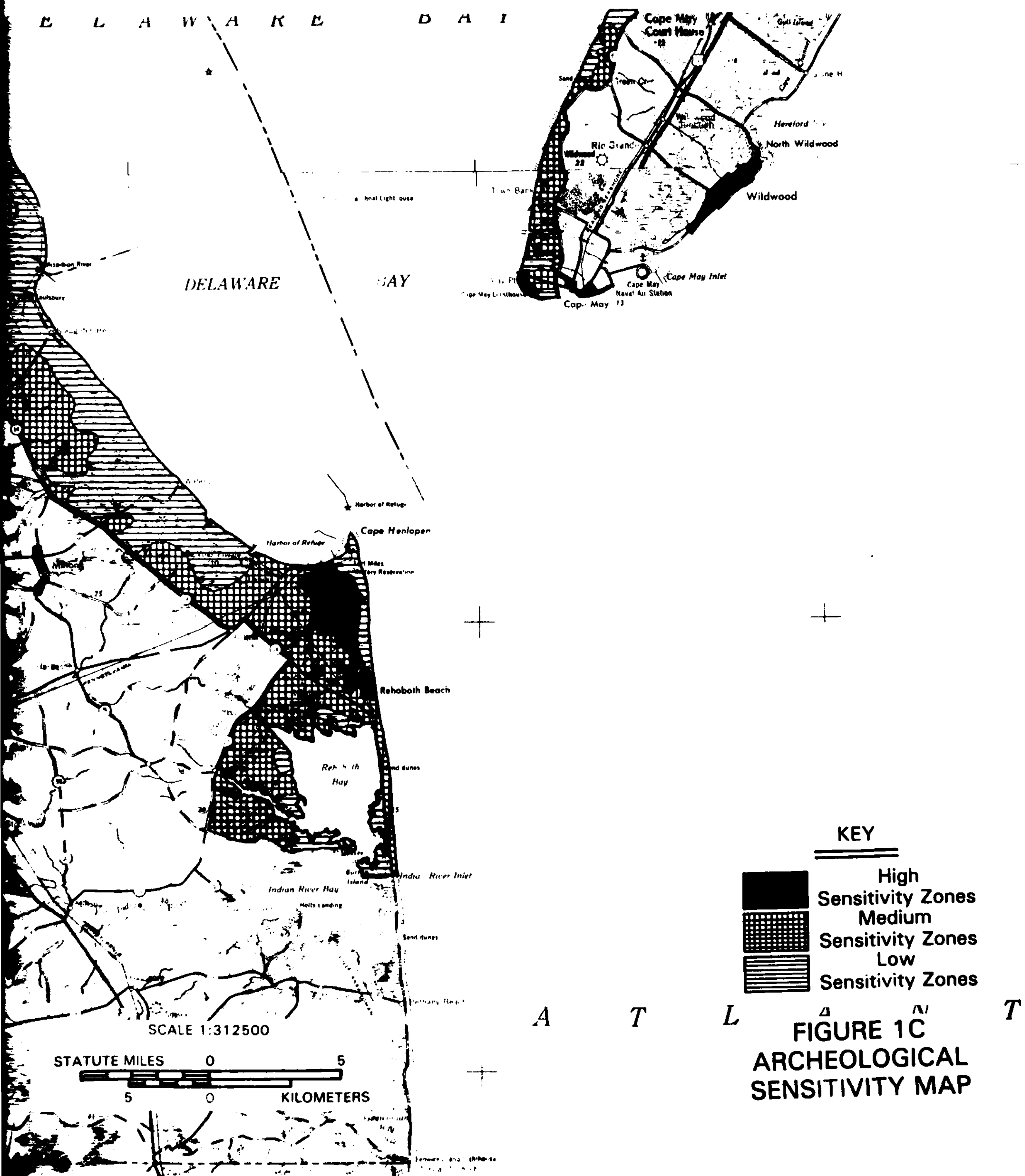


FIGURE 1C
ARCHEOLOGICAL
SENSITIVITY MAP

It should also be noted that these 162 inventoried historic sites do not comprise a complete listing of all properties of historic significance which might be adversely affected by the dredge spoil disposal plan. Comprehensive historic structure surveys have only been conducted in two of the thirteen counties in the project study area: Sussex County, Delaware and Burlington County, New Jersey. Even in these two counties, determinations of eligibility have not been made for all surveyed sites. Thus, it must be concluded that the study area contains numerous historically significant sites and structures which have not yet been surveyed and nominated to protected historic register status.

In the absence of comprehensive structure survey and designation, it is difficult to create a satisfactory project area model for zones of historic site potential. The inventoried historic property data can be discussed: included in the list of 162 designated sites are 22 historic districts which contain properties dating from different periods; 6 individual structures were built prior to 1700; and 73 individual structures were built between 1700 and 1800. Though this compilation of numbers and dates provides statistics on the progress of historic designation along the Delaware River and Bay, it reveals nothing about potentially significant properties which have not yet received historic designation. Likewise, the Figure 2 maps show the location of designated historic structures, but they do not locate eligible structures.

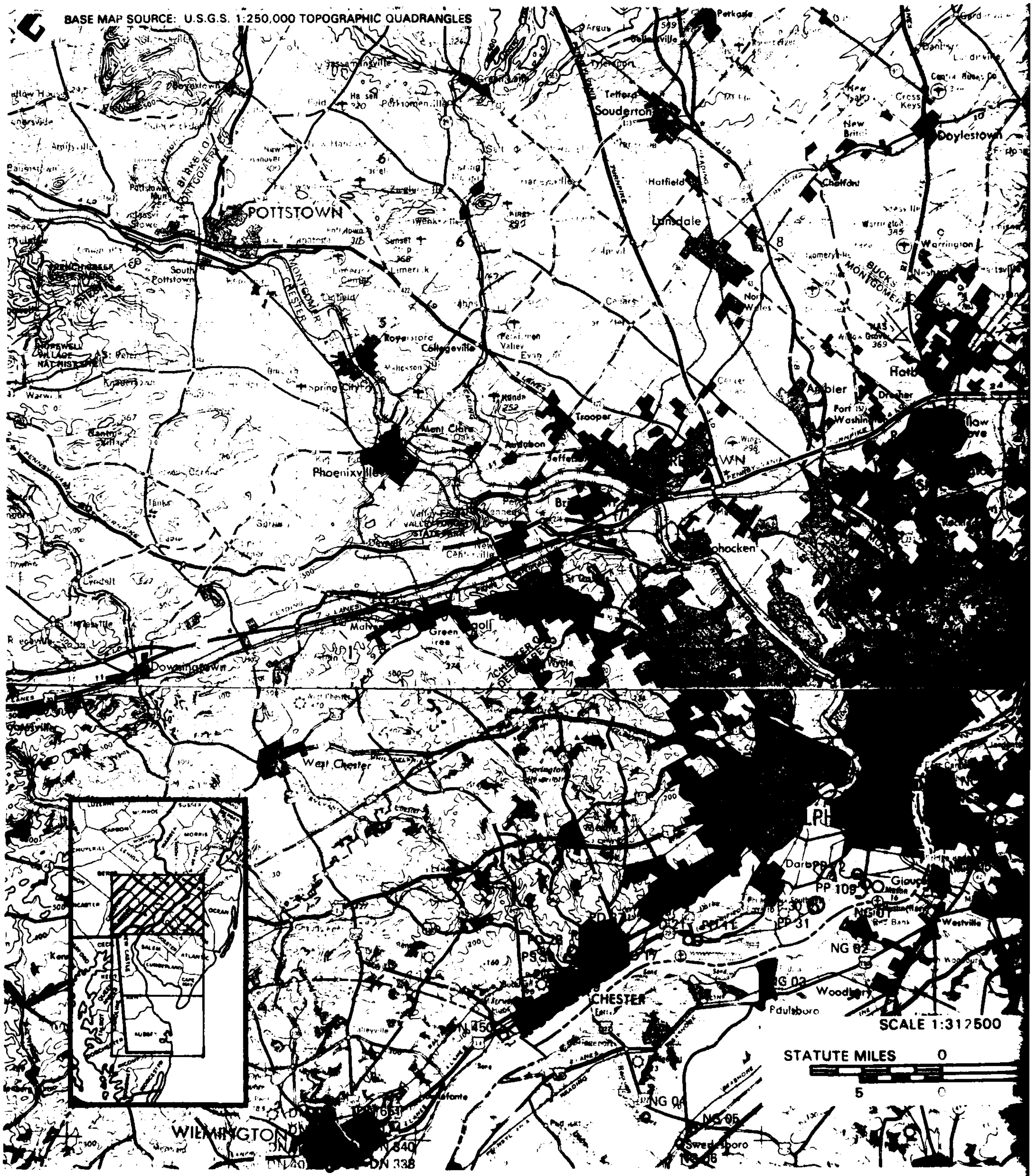
Two attempts have recently been made to develop predictive models for historic settlement patterns along portions of the Delaware Bay. Carol Wise, Historical Archeologist for the Delaware Bureau of Archeology and Historic Preservation, has recently presented two excellent papers which state that Delaware's early historic settlement pattern involved dispersed single family farmsteads located close to the edge of well drained soils. The earliest settlements were near the stream mouths on the Delaware, while later settlements were located farther inland. Wise notes that by around 1730 the location of farmsteads began to shift away from creek beds to roads which were located at drainage divides. She correlates this change in settlement from drainage edge to drainage divide and from river access to road traffic with a change in agricultural production from tobacco to wheat (Wise 1978; Wise October 1978).

The settlement model presented by Wise suggests that the well drained site of the transition zone between well and poorly drained soils should be carefully examined for evidence of early European settlement. She further suggests that later eighteenth century structures tend to be located along mid-drainage roads. These important generalizations, however, are based primarily upon extensive survey in Sussex County,Delaware, an area little characterized by colonial urbanization. Different geological drainage patterns and

different patterns of urban settlement may render her conclusions inapplicable to other regions of the Delaware River and Bay (Historic Resources of St. Jones Neck 1979).

Barbara Liggett has compiled a Historical Gazetter of New Jersey which dates the use of place names for all political subdivisions of New Jersey government: counties, townships, boroughs, and cities. Then,by cross-referencing current road map place names with the place names found in the Historical Gazetter, Liggett has prepared sensitivity maps of projected and known areas of historic importance for Cape May County and the Maurice River drainage in New Jersey. But such mapping only indicates that a political subdivision has preserved its historic name, not that it has preserved its historic structures. Thus, in the opinion of the Commonwealth project historian, such mapping is of little value unless it is substantiated by comprehensive on-site historic structure survey (Liggett 1977; Bartlett 1978).

Because the Delaware River and Bay have not been subjected to comprehensive historic structure survey and evaluation of significance and because no predictive models of historic site sensitivity have been developed which can apply to all portions of the River and Bay, the Commonwealth project team recommends that additional site-specific historic survey and evaluation be conducted prior to the final selection of each location chosen for spoil disposal.



PB 20
PB 22
PB 11
PB 10
PB 01
PB 28
PP 32
PP 63
PP 130
PP 40
PP 75
PP 77
PP 38
PP 06
PP 72
PP 109
PP 30
PP 31
PD 37
PD 27
PD 17
PD 19
PD 21
PD 11
PD 28
PD 22
PS 30
DN 450
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DN 874
DN 340
DN 338
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DN 651
DN 3637
DN 4018

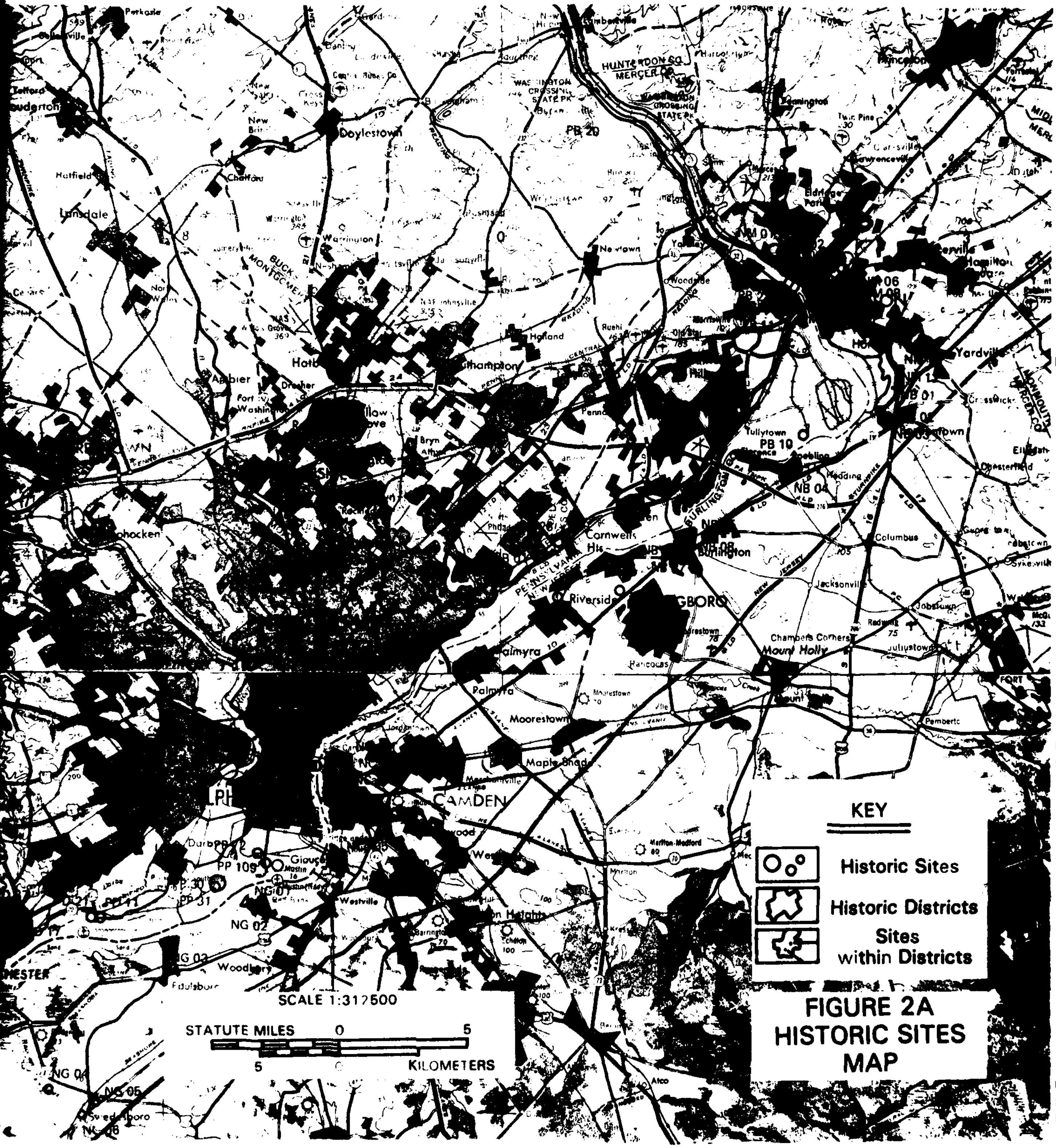


FIGURE 2A
HISTORIC SITES
MAP

NM 01
NM 02
NM 03
NM 04
NM 05
NM 06
NM 07
NM 08
NM 09
NM 10
NM 11
NM 12
NM 13
NM 14
NM 15

NB 01
NB 02
NB 03
NB 04
NB 05
NB 06
NB 07
NB 08
NB 09
NB 10

NCa 01
NCa 02
NCa 03
NCa 04
NCa 05

NG 01
NG 02
NG 03
NG 04
NG 05
NG 06

DN 1423
DN 246
DN 403
DN 386
DN 399
DN 362
DN 1475
DN 385
DN 1290
DN 349
DN 1306
DN 219

DN 145
DN 1559

DN 144

DN 3935
DN 3932
DN 1623
DN 3928
DN 147
DN 148
DN 150

DN 424
DN 154
DN 416
DN 126
DN 125

DN 152
DN 151
DN 419
DN 423

DK 133

DK 101

DK 131
DK 132

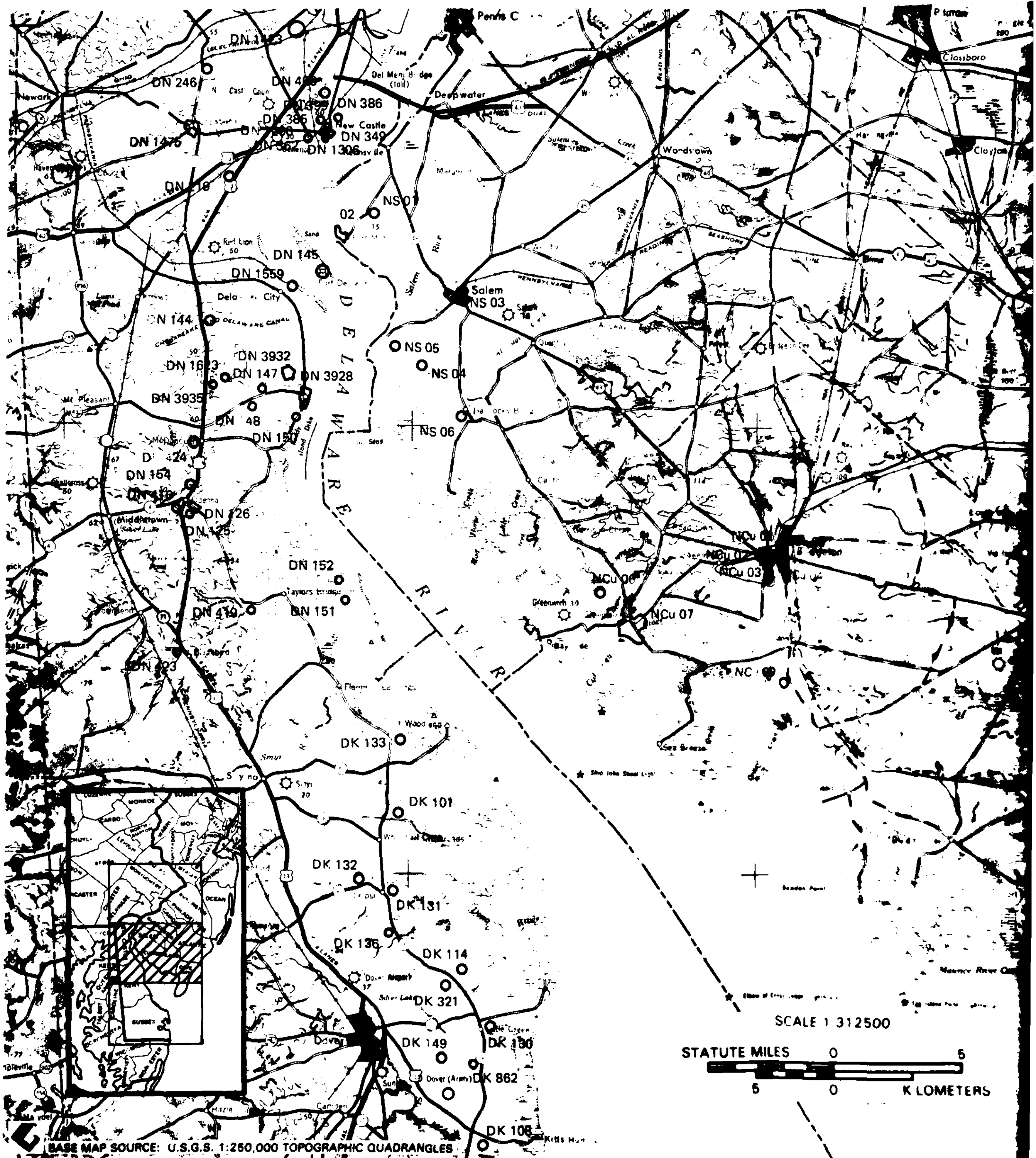
DK 136

DK 114
DK 321

DK 130

DK 149
DK 862

DK 108



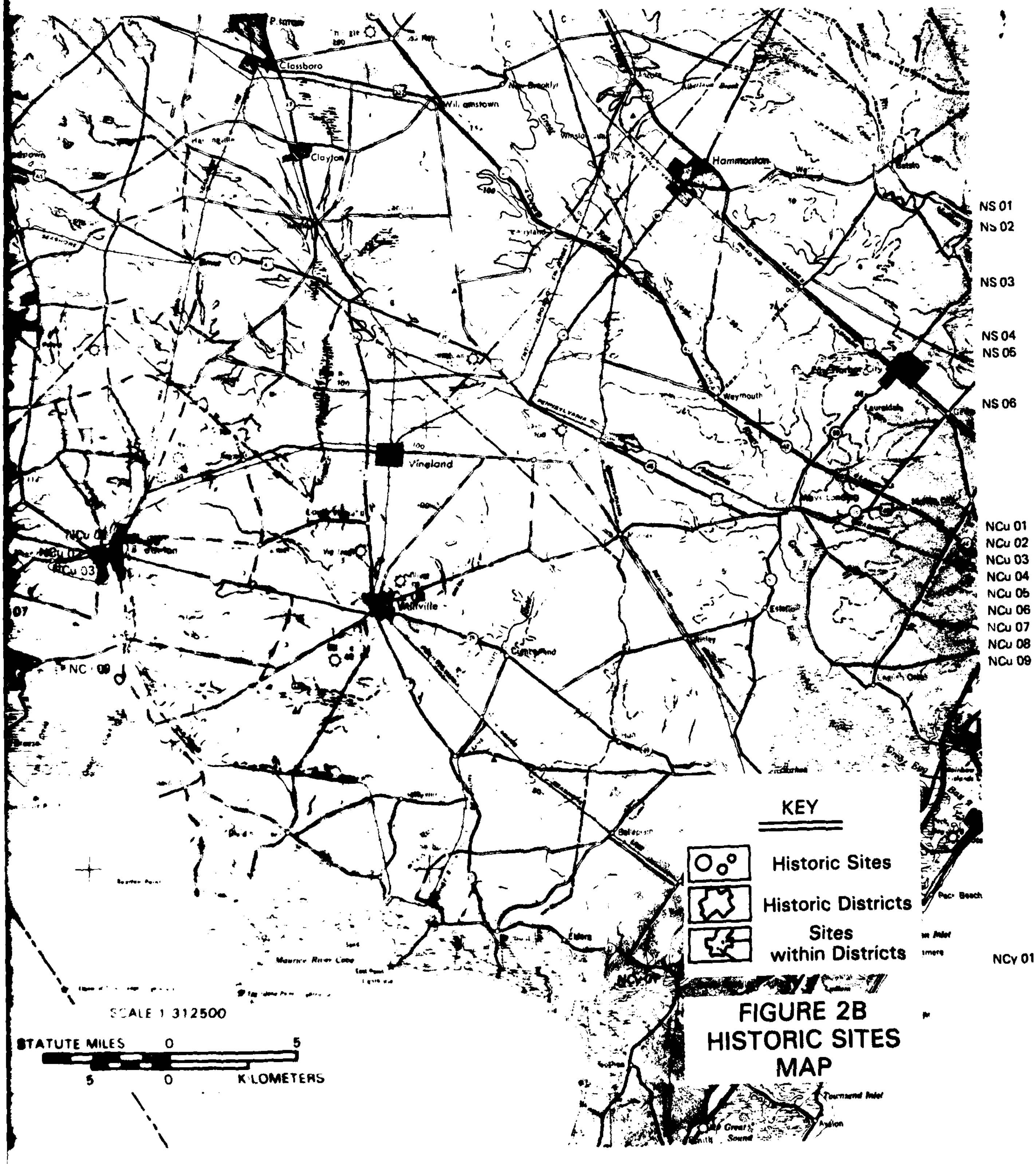
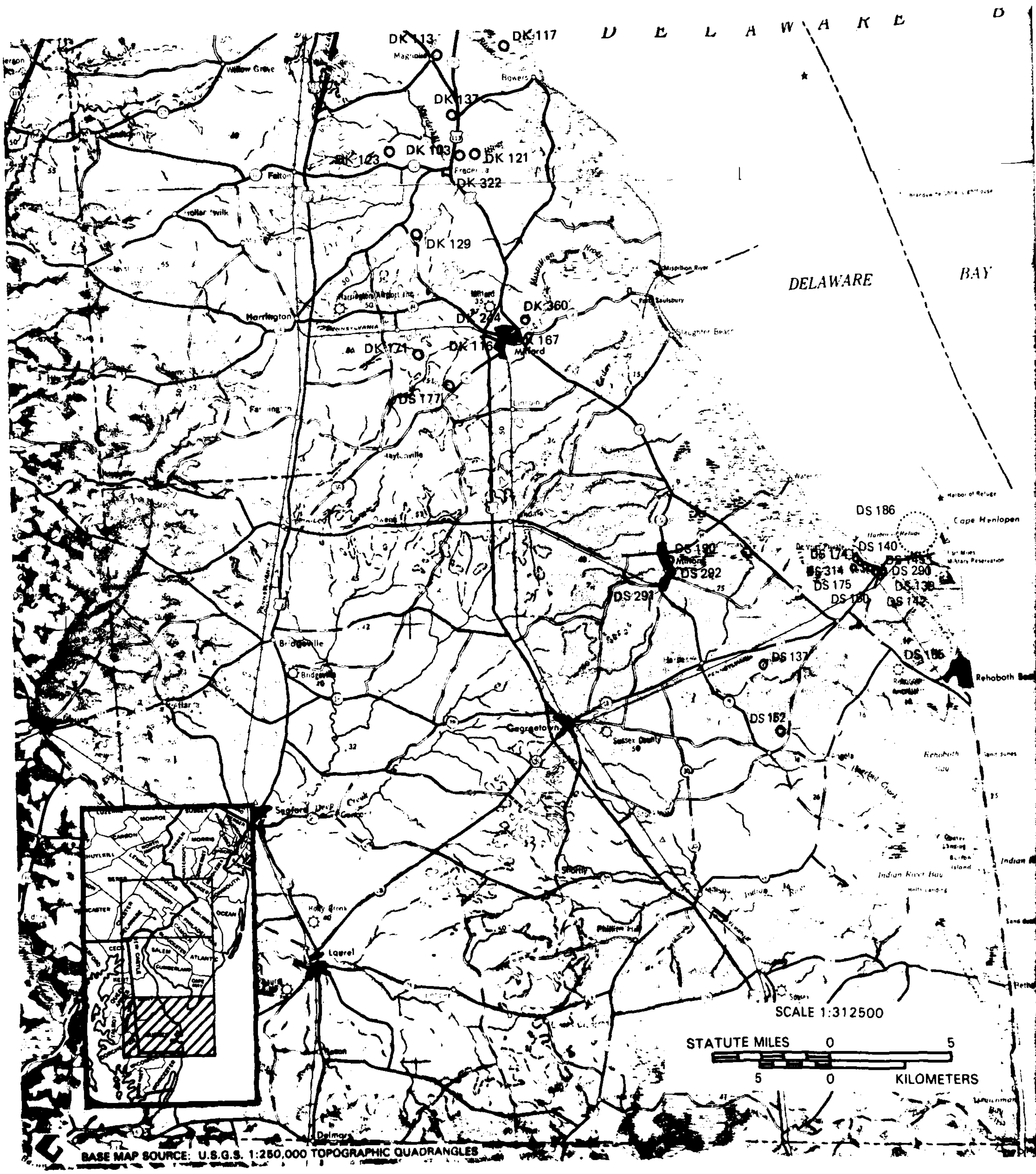


FIGURE 2B
HISTORIC SITES
MAP

DK 117
DK 113
DK 137
DK 121
DK 103
DK 123
DK 322
DK 129
DK 360
DK 244
DK 167
DK 116
DK 171
DS 177
DS 186
DS 160
DS 174
DS 175
DS 140
DS 314
DS 190
DS 139
DS 142
DS 290
DS 145
DS 291
DS 292
DS 137
DS 155
DS 152



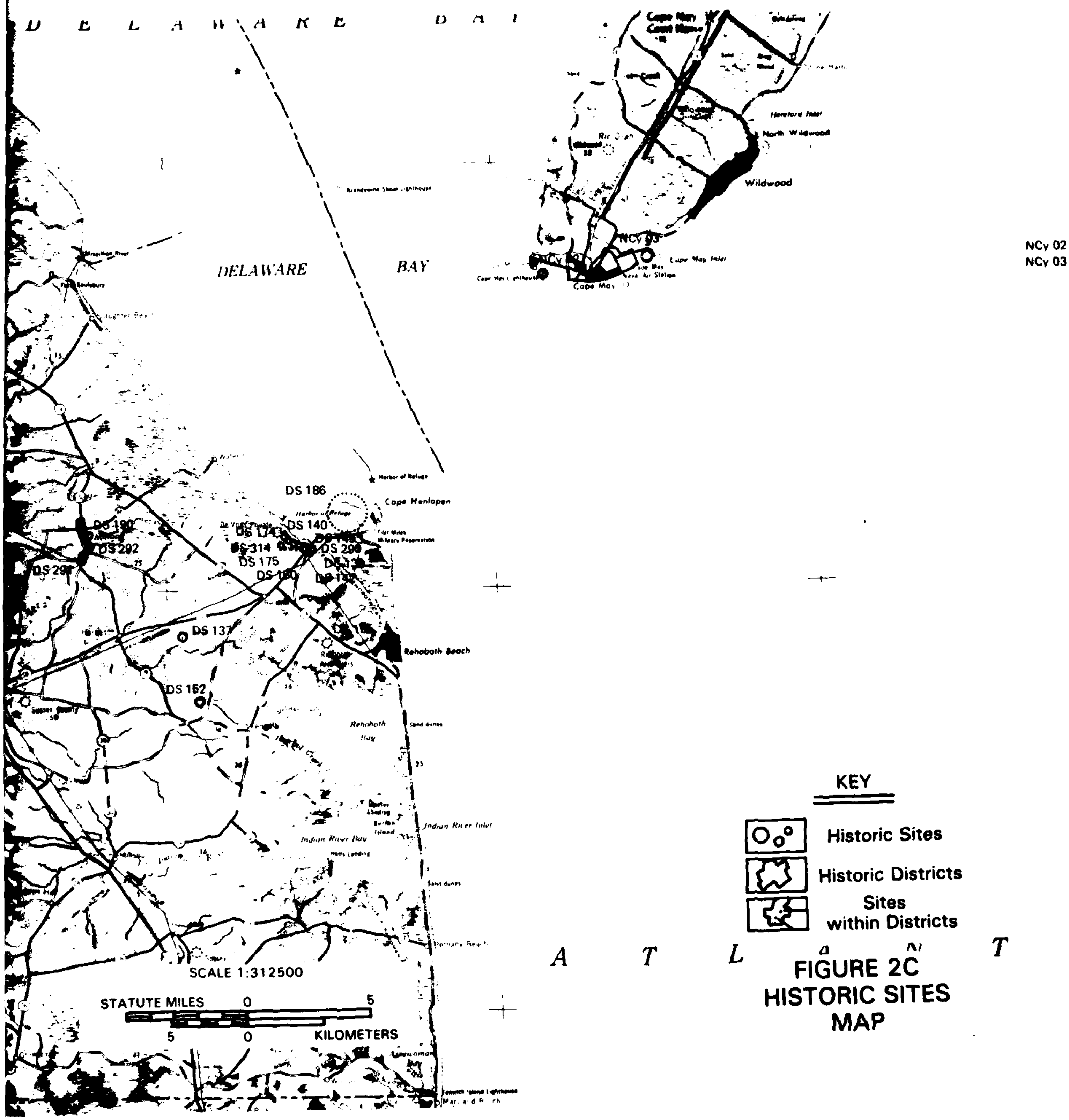


FIGURE 2C
HISTORIC SITES
MAP

APPENDIX

PHILADELPHIA HISTORICAL COMMISSION
1313 City Hall Annex
Philadelphia, Pennsylvania 19107
MU 6-4543 and MU 6-4583

CITY OF PHILADELPHIA

8 February 1979

John R. Kern, Ph.D
Historic Preservation Planner
Gilbert/Commonwealth
Commonwealth Associates Inc.
209 E. Washington Avenue
Jackson, MI 49201

RE: 62-0131-005

Dear Dr. Kern:

I have reviewed the list of historic sites in your letter of 29 December 1978 and should like to add three more. They are the Old City National Historic District and Fairmount Park and the Spring Garden National Historic District.

The first of these is bounded on the north by Wood Street, on the west variously by Fifth Street and Fourth Street, on the south by Independence National Historic Park and the Society Hill National Historic District, and on the east by Front Street.

Fairmount Park is on the National Register as a National Historic Landmark. It extends along both banks of the Schuylkill River from Spring Garden Street to the Wissahickon Creek and along both banks of that stream to Northwestern Avenue.

The Spring Garden National Historic District is bounded on the north variously by Fairmount Avenue and Green Street, on the east variously by Nineteenth Street and Fifteen Street, on the south by Spring Garden Street and on the west by Twenty-fourth Street.

In addition you may wish to consider any impacts on the Thirtieth Street Station and College Hall, both National Register properties, as well as the academic campus of the University of Pennsylvania which has been nominated to the Register.

John R. Kern, Ph.D
8 February 1979
Page Two

The significance for each of these additions may be determined by consulting the National Register nomination forms.

I hope that this proves of some assistance to you.

Yours truly,

Richard Tyler

Richard Tyler
Historian

RT:mk

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SECTION D-2

GILBERT/COMMONWEALTH

R-1998

CULTURAL RESOURCES OVERVIEW
AND
SENSITIVITY ANALYSIS
FOR THE
DELAWARE RIVER AND BAY

SUBMITTED TO
U.S. DEPARTMENT OF THE ARMY
Philadelphia District
Corps of Engineers
Custom House
2D and Chestnut Streets
Philadelphia, Pennsylvania 19106

PREPARED UNDER THE SUPERVISION OF
James E. Fitting, Ph.D.
Principal Investigator

John R. Kern, Ph.D. - Project Manager/Historian
Stephen R. Claggett - Project Archeologist

CONTRACT DACW61-78-D-0013
WORK ORDER NO. 0005

February 16, 1979

TABLE OF CONTENTS

INTRODUCTION

In 1978 Gilbert/Commonwealth contracted with the Department of the Army, Philadelphia District, Corps of Engineers to conduct Historical Resources Reconnaissance Services and Investigations in the Philadelphia District Area. Work Order 0005 called for a cultural resources overview and sensitivity analysis of data for shoreline areas bordering Rehoboth Bay and Lewe and Rehoboth Canal in Delaware and Delaware Bay and River from the Atlantic Ocean to Trenton, New Jersey.

The Work Order 0005 cultural resources study is being conducted in conjunction with the Philadelphia District, Corps of Engineers' Delaware River and Bay Dredging Disposal Study. Authorized by the United States Senate Committee on Public Works in October 1974, and initiated in February 1978, the study is intended to develop a regional spoil disposal plan for the tidal portions of the Delaware River, its tidal tributaries, and Delaware Bay. The Delaware River is tidal upstream to Trenton, New Jersey; the tidal tributaries and other project sites have been defined as follows: Neshaminy State Park Harbor, Pennsylvania; Schuylkill River, Pennsylvania, mouth to University Avenue, 6.5 miles; Wilmington Harbor, Christina River, Delaware, 9.9 miles; Smyrna River, Delaware, 9.5 miles; Little River, Delaware, 3 miles; Murderkill River, Delaware, 8.5 miles; Mispillion River, Delaware, mouth to

Milford, approximately 11 miles; Broadkill River, Delaware 10.3 miles; Harbor of Refuge, Delaware; Cooper River, New Jersey, 1.8 miles; Big Timber Creek, New Jersey, 5.5 miles; Mantua Creek, New Jersey, 7 miles; Racoon Creek, New Jersey, 9.8 miles; Salem River, New Jersey, 5 miles; Cohansey River, New Jersey, 19.5 miles; and the Maurice River, New Jersey, 24 miles (COE 1978).

Gilbert/Commonwealth has undertaken Work Order 0005 to provide the following services for the Delaware River and Bay dredging disposal study.

I. Literature and records background search

  a. with attention to archeological sensitivity analysis based upon

    1) environmental factors which have influenced human occupation;

    2) review of regional literature and State Historic Preservation Office archeological site files;

  b. with attention to historic sites based upon

    1) a comprehensive review of State Historic Preservation Office historic site inventories;

    2) preparation of abstracts and locational mapping for protected historic sites.

Literature and records research was conducted in Pennsylvania at the Office of Historic Preservation, Pennsylvania Historical and Museum Commission in Harrisburg between

December 4 and 6, 1978. Commonwealth project archeologist Stephen R. Claggett conferred with Curator of Archeology Barry C. Kent, and Archeologist Ira F. Smith, III. Project historian John R. Kern worked with Curator and Environmental Review Specialist William O. Hickok and Curator and National Register Coordinator Susan M. Zacher. At the advice of Mr. Hickok, Kern subsequently corresponded with Kathryn Ann Auerbach, Historical Programs Coordinator for the Bucks County Conservancy; Richard Tyler, Historian for the Philadelphia Historical Commission; and Martha Wolfe of the Brandywine Conservancy; (Ms. Auerbach reported January 1979 that the Bucks County Conservancy has not yet surveyed the lower part of Bucks County; see Appendix for response from Richard Tyler received February 12, 1979).

Literature and records research was conducted in Trenton, New Jersey at the Office of Historic Preservation, New Jersey Department of Environmental Protection, where Kern worked primarily with Architectural Historian William McCrea; the Office of Environmental Review, New Jersey Department of Environmental Protection where Claggett conferred primarily with Archeologist Olga Chesler; and the New Jersey State Museum where Claggett consulted with State Archeologist Lorrain Williams and Staff Archeologist Karen Flinn. The records and literature search in Trenton, New Jersey was carried out December 6 to 8, and 11, 1978.

Literature and records review was conducted in Delaware at the Department of State, Division of Historical and Cultural Affairs, Bureau of Archeology and Historic Preservation at the Hall of Records in Dover between December 12, and 14, 1978. Claggett and Kern worked with Historical Archeologist Cara L. Wise, and Kern conferred with Historian Dean E. Nelson.

Minor site verification was carried out at Cape May by Claggett and Kern on December 9 and 10, 1978. On December 10, project staff members were accompanied by Robert Logan, President of the Greater Cape May Historical Society. Additional site verification was made at the Island Field Site in Kent County, Delaware by Claggett on December 13 and 14, 1978. On December 13, Claggett was accompanied by Historical Archeologist Cara Wise. No additional on-the-ground archeological investigations were carried out during the reconnaissance.

ENVIRONMENTAL BACKGROUND

Discussion of the environmental factors that have influenced human occupation of the Delaware Bay margins must recognize the time depth involved and the climatic, geologic and hydrologic changes that have occurred. A large body of current research concerns regional questions of natural/cultural interactions or has a direct bearing on investigations of archeological manifestations in the coastal zone (J. Kraft 1977; Kraft and John 1978; Fairbridge 1977; Sirkin 1977; Edwards and Emery 1977; Edwards and Merrill 1977; Thomas et al. 1975; Griffin 1976). Man has occupied the area for at least 10,000 years, and perhaps as much as 40,000 years before present (B.P.) (J. Kraft 1977: 44; Thomas 1974; Mason 1971; H. Kraft 1974; 3-7, 1977). Dramatic fluctuations in climate, sea level and floral/faunal patterns during even the last 5-6,000 years have influenced, and will continue to influence, human settlement along Delaware Bay.

The geomorphic setting of Delaware Bay is that of a drowned river valley or estuary. The present coastal plain and offshore continental shelf are formed of cretaceous and Miocene-Pliocene(?) age sediments, covered in most places with Quaternary age sands, gravels and clays (J. Kraft 1977; Johnson 1950; Widmer 1964). Lowering of world sea levels ca. 40,000 years B.P. resulted in exposure of the continental shelf for a distance of 75-100 km from the present shoreline, coupled with entrenchment of the ancestral Delaware

River and formation of a series of river terraces. Melting of glacial ice masses during the last 10,000 years has reversed the process, resulting in gradual, yet variable, rates of coastal submergence (J. Kraft 1977; Thomas et al. 1975).

Rising ocean levels and resultant encroachment of salt water tolerant species and formation of tidal marshes have placed dynamic strictures on human settlement of the bay margin. Boreal forest communities typified the region during the Pleistocene, but were gradually replaced by deciduous (oak, hickory) climax species during the early Holocene, and black gum and cypress in some areas by 5-6000 B.C. (Whitehead, 1973) coincidental, with coastal submergence and resultant establishment of estuarine plant and animal communities. Fossil pollen samples, wood and peat species and extinct megafaunal remains (mammoth, mastodon, walrus, ground sloth) have been recovered from various onshore and offshore contexts and attest to this long-term series of climatological and floral/faunal changes (J. Kraft 1977; Edwards and Merrill 1977; Sirkin 1977; Kraft and John 1978). Aboriginal exploitation of these changing environments consisted of hunting and gathering of extinct and modern game, forest products and littoral resources (especially fish and shellfish) (H. Kraft 1974; Thomas 1974). Yet, little direct evidence remains of early occupational sites, due to their probable orientation along the drowned river and bay margins.

The gradual shift to modern conditions has been completed only within the last 2-3,000 years (J. Kraft 1977; Thomas et al. 1975; Griffith 1976; Robichand and Buell 1964). Geological and archeological data indicate an essentially modern climate and floral/faunal communities since that time. Prehistoric sites have yielded evidence for exploitation of white-tail deer, elk, black bear, turkey, raccoon, muskrat, various birds and waterfowl, fishes, turtles and several types of shellfish. Plant remains are less common, but sites were evidently situated to maximize access to marsh and upland varieties of nuts, seeds, roots, reeds and "greens" (Thomas et. al. 1975; Griffith 1976; H. Kraft 1974; Cross 1941). Tropical cultigens (maize, beans, squash) were added to this list some time around A.D. 1000, and whaling was practiced by at least the seventeenth century (Dickinson 1972).

In general terms, Delaware Bay microenvironments encompass several interfacing habitats: coastal beaches and dunes; shallow lagoons and tidal marshes;coastal plain uplands; tributary streams; and dissected piedmont uplands. Most of the study area is within the Atlantic Coastal Plain province,with predominantly sandy soils and habitats combining shorelines, lagoons, marshes, tidal estuaries and adjacent uplands. Tidal estuaries and marshes dominate the lower half of the Bay margins, while a relatively flat

floodplain is present along the Delaware up to the fall line (Johnson 1950; Widmer 1966). The upstream portion of the study area includes the Delaware floodplain, low river terraces, uplands and their draining tributary streams, all of which are part of the Piedmont Crystalline Province (J. Kraft 1977). Natural communities have been virtually eliminated along portions of the drainage, particularly as the result of urban and industrial developments during the twentieth century.

ARCHEOLOGICAL BACKGROUND

A review of regional literature and state site files indicates that variable data are available on prehistoric archeological sites along the margins of Delaware Bay. Centralized files in the three states of Delaware, Pennsylvania and New Jersey contain site data based on information derived from sources as variable as recent systematic surveys and amateur collector's reports from the turn of the century. In general, site information from Delaware is rather complete, due to efforts in the last decade to systematically survey coastal and drainage areas throughout the state. The Pennsylvania portion of our study area lacks all but the most rudimentary site data, largely due to heavy urbanization and industrialization of the Philadelphia area. New Jersey files contain site records from selected drainages, largely derived frcm intuitive surveys conducted during the first three decades of this century (Skinner and Schrabisch 1913; Cross 1941).

Comparisons of data from the three-state region are understandably difficult. A general discussion of the prehistoric background of the Bay area can be offered, nevertheless, based in part on published sources from the larger Middle Atlantic Coast region.

The major cultural/historical traditions identified for eastern North America are the Paleo-Indian (15,000-8,000 B.C.), Archaic (8000-1,000 B.C.), Woodland (1,000 B.C.-A.D. 1,000) and Mississippian (A.D. 900-1,500) stages or traditions (Griffin 1967; Dragoo 1976). Evidence exists for only the first three traditions in the Delaware Bay region; Algonquian groups present at the time of white contact were living basically Woodland lifeways and did not participate in the social, religious and political systems that identify Mississippian culture groups (Thomas 1974; H. Kraft 1974; Goddard 1978; Snow 1978).

Paleo-Indian

Paleo-Indian sites in the greater Bay region consist mainly of isolated finds of fluted projectile points, occasionally associated with less diagnostic knives, scrapers or other implements. In keeping with current interpretations, it can be argued that Paleo-Indian settlement/subsistence patterns involved hunting of Pleistocene megafauna and certain northern Holocene forms (caribou, musk ox) and gathering of available plant foods. No evidence exists for direct exploitation of littoral resources. Relative scarcity of sites and artifacts is taken as an indicator of low population density and a nomadic lifestyle, but a general lack of data is attributable to the presumed destruction of many sites by coastal submergence over the last 12,000 years (J. Kraft 1977; H. Kraft 1974, 1977; Edwards and Emery 1977; Mason 1971; Bryan 1977).

Archaic

A similar situation obtains for at least the early portion of the Archaic stage (8000-4000 B.C.). Holocene climate changes resulted in modified biotic patterns as well as rising sea levels. Changes in artifact styles are viewed elsewhere as indicative of a gradual transition from Paleo-Indian to increasingly regionalized Archaic traditions (Adovasio et al. 1977; Morse 1973; Coe 1964; Broyles 1971; Gardner et al. 1977). This transition either did not occur in the Delaware Bay region or has not been recoginzed (Thomas 1964; H. Kraft 1974). Early Archaic sites are known for the upper Delaware and the lack of information from the Bay area again reflects site destruction due to flooding.

Middle and Late Archaic settlement patterns also are poorly understood, but increased populations are inferred and recognizable tool forms reflect participation in extra-regional traditions termed Piedmont Archaic and Laurentian (Thomas 1974; H. Kraft 1974; Kensey et al. 1972).

Archaic settlement/subsistence patterns were predicated on coalescence or dispersal of kin-based groups for exploitation of seasonally available foods or other resources (Caldwell 1958; Kent 1970). It has been argued that this "diffuse" economic pattern reached a level of refinement called Primary Forest Efficiency (Caldwell 1958; Cleland 1976) during the Late Archaic period, but recent

research indicates that highly scheduled and efficient patterns existed during the Early Archaic (Chapman 1977) and continued to function into the historic period (Thomas et al. 1975; Mounier 1974; Griffith 1976; Snow 1978).

Transitional

A transitional phase has been defined for the Middle Atlantic region during the period from 1800-1000 B.C. Increased sedentism is implied, based on more substantial village remains and the presence of soapstone cooking vessels, which would have limited, to some extent, the transhumance patterns typical of earlier Archaic groups. Certain lithic tool forms also are typical of this period, which, as the name implies, is "transitional" between the Late Archaic and early Woodland cultural/historical periods (H. Kraft 1974; Witthoft 1974).

Woodland

Woodland period groups in the Delaware Bay region are identified basically by the use of ceramics and peripheral participation in rather flamboyant Early and Middle Woodland traditions termed Adena and Hopewell elsewhere (Dragoo 1976; Pollak n.d.; DeValinger 1970; Cross 1956). Design elements found on ceramic sherds allow distinctions to be made between localized Woodland groups (Lopez 1961) as well as allowing fairly precise analyses of external relationships (H. Kraft

1974;Cross 1941). Larger populations were concentrated in Woodland villages and increased status differentation is inferred for burial details. Increased sedentism is attributable to the introduction of tropical cultigens, especially maize, some time around A.D. 1000, but Woodland groups continued to participate in seasonal rounds of food-gathering and, possibly, social contacts.

Archeological investigations in the area bordering Delaware Bay historically have concentrated on Woodland period sites, evidently because of their visibility and large size(DeValinger 1970; Thomas and Warren 1970a, 1970b). Amateur and professional attentions have focused on ceramic period sites due to their potentially well-preserved artifact and featural contents of burials, storage pits, hearths, middens and house patterns. As discussed previously, older Paleo-Indian and Archaic sites usually offer a less complete array of specimens, and represent only a small remnant of the possible variations in site size and content. Most analyses of prehistoric life in the Bay region are based on data from large Woodland period sites such as Mispillion, Island Field, Hughes-Willis, Poplar Thicket, Cape Henlopen and Townsend in Delaware. Woodland sites in southeastern Pennsylvania remain undiscovered or are destroyed.

New Jersey sites have not been rigorously explored or reported in the literature, except along the upper Delaware or inland from the river and bay (Snow 1978; H. Kraft 1974; Thomas 1974; Thomas et. al. 1975; Cross 1941; Skinner and Schrabish 1913; Kinsey 1972). Recorded sites in southern New Jersey and southeastern Pennsylvania are either poorly documented or do not otherwise lend themselves to ready cultural/historical identification or processual interpretation (cf. Cook 1960, 1969). Basic Late Archaic and Woodland relationships have been defined, however, at sites in the Maurice River drainage of southern New Jersey (Mounier 1974).

Late Woodland groups occupied large base camps on the central portions of Delaware Bay tributaries but continued to fragment into seasonally smaller units for the seasonal exploitation of various estuarine and upland resources (Thomas et al. 1975; Griffith 1976; Mounier 1974). Maize production was an important part of Late Woodland economics, but never to the extent of late prehistoric (especially Mississippian) groups elsewhere in eastern North America.

<u>Contact</u>

Contact period aboriginal groups inhabiting the Delaware Bay region are identified as Algonquian- speaking

Delaware, or Lenape (Snow 1978; Goddard 1978; Hunter 1974; Weslager 1953; Thomas and Lewis 1966). Some evidence suggests, however, that the Late Woodland Slaughter Creek phase in the lower reaches of the Bay (Lewes-Rehobeth area) was more closely related to historic Algonquian, Nanticokes, Assateague. Choptank and Pocamoke groups of the Chespeake Bay region (Thomas 1974; 17). Townsend series ceramics found on sites in southern Delaware are definiens for the Slaughter Creek phase (Snow 1978; 63; Thomas and Lewis 1966).

Less intensive research has been devoted to late sites in southern New Jersey, but early documents indicate that Lenape groups were historic inhabitants (Cross 1941; Skinner and Schrabish 1913; H. Kraft 1974; Weslager 1972). Sources tend to indicate that the east side of the Bay was more intensely occupied than the west side (Goddard 1978; 215; cf. Johnson 1925). Investigations by Mounier (1974) demonstrate gross similarities between the Late Woodland Fralinger site on the Maurice River and larger Middle Atlantic cultural traditions, but "...social organization and the relationship between archeological cultures and ethnohistorically described groups in this area await elucidation" (Mounier 1974: 54).

Historic

Goddard (1978:214) identifies several historic Delaware groups in the Bay area -- Unami speakers whose settlements were aligned along major stream drainages. The groups and their locations listed by Goddard are as follows: Sewapois (Cohansey River); Little Siconese (Salem River); Naranticonck (Raccoon Creek); Mantaes (Mantua Creek); Armawamex (Big and Little Timber Creeks); Remkokes (Rancocas Creek); Atsayonck (Crosswicks Creek); and Sankhikans (near the falls at Trenton). Settlements or groups mapped for Pennsylvania include Minquannan (White Clay Creek), Quineomessinque (Brandywine Creek), and by the late seventeenth century, Okehocking (Ridley and Crum Creeks) and Playwicky (upper Neshaminy Creek). Rapid depopulation and political disruption of eastern Pennsylvania during this period has been attributed to conflicts with Susquehannocks from further north along the Delaware (Goddard 1978:215).

Southern Unami groups were apparently involved in close trans-Bay contacts; the sole group recorded by Goddard for Delaware (Lewes - Cape Henlopen area) is the Big Siconese, an apparent "tribal variant of the Little Siconese in New Jersey (see above; Goddard 1978; 215). Relationships between the Big Siconese and the Late Woodland Slaughter Creek phase are unclear.

Subsistence/settlement patterns of early historic Delaware groups varied little from precedents established during prehistoric Archaic and Woodland periods. Permanent base camps or villages, usually situated at mid-drainages, were abandoned during winter and summer for satellite camps where activities involved hunting, gathering or fishing. Warfare also has been cited as an impetus for periodic dispersals(Goddard 1978:216-217). These ancient patterns were seriously and rapidly disrupted in the seventeenth century, as trade with the Dutch reoriented the Delaware economy. Settlements were consolidated as the result of land sales,with period group fragmentation for fur-hunting or trading activities. European trade goods and introduced food-stuffs also contributed to disruption of traditional patterns.

Delaware occupation of the Bay region was ended effectively by the late seventeenth century, reflected in a gradual westward movement of local groups into Pennsvlvania. Claims of certain southern Unamis (in New Jersey) ended with their relocation to the Brotherton reservation in 1758. Later history involves various consolidations with Shawnee, Iroquois, Wyandot and other native groups in New York, Ohio, Pennsylvania and,eventually, Oklahoma (Goddard 1978; Weslager 1972).

HISTORIC OVERVIEW

Historic Background

The first Europeans to reach Delaware Bay were explorers who sailed for the Dutch. Henry Hudson put into the Bay in 1609 while under the employ of the Dutch East India Company. In the early 1620s Cornelius Jacobsen May headed a Dutch West India Company colonizing expedition which sailed up the Delaware Bay. Around 1624 several Dutch families established Fort Nassau, now Glocester, New Jersey. In 1631 another group of Dutchmen formed a trading company headed by David Pieterssen deVries. An expedition financed by their company created a settlement near the present town of Lewes, Delaware in 1631, but when deVries reached the outpost in 1632, he found that all its inhabitants had been killed by Indians (Ward 1930; Hawke 1960).

During the 1630s Dutch control of Delaware Bay was contested by the Swedish West India Company. Commanded by Peter Minuit, the first Swedish expedition in 1638 founded Fort Christina, now Wilmington, Delaware. Subsequently headed by Johan Prinz, the Swedish colony expanded during the 1640s to encompass both shores of the Delaware River and Bay from the Schuylkill River to Cape Henlopen on the western shore and from the mouth of Assunpink Creek, now Trenton, to Cape May on the eastern shore (Ward 1930; Billington 1960).

The struggle for control of the region's profitable fur trade became three cornered in the 1640s when a group of New England merchants organized as the Delaware Company and, led by George Lamberton, built a post at the site of Philadelphia. This and a second attempt at settlement were thwarted by both Swedish and Dutch forces (Dunway 1948).

Having eliminated the New Englanders, Dutch and Swedes opposed one another for control of the Delaware. The rivalry focused on the present site of New Castle, Delaware, where in 1651 the Dutch built a post named Fort Casimir. Swedes seized the fort in 1654. But the next year, Dutch troops commanded by Peter Stnyvesant captured all Swedish strongholds and forever ended Sweden's claims to the region (Hawke 1966; Ward 1930). The Dutch immediately consolidated their Delaware Bay holdings by reorganizing the Fort Casimir settlement as New Amstel. Headed by Alexander d'Hinoyossa in 1659 the outpost secured possession of all lands on the west bank of the Delaware and a strip three miles wide along the east bank. During this period the trading post near the present town of Lewes was reestablished (Scharf 1888).

England saw Dutch settlement along the Hudson and the Delaware as a threat to British colonial expansion and an obstacle to enforcement of the newly instituted Navigation Acts. Consequently, in 1664 Charles II, wishing to reward the

commerical classes who had supported his restoration, ordered the capture of all Dutch possessions in America. Four frigates reached New Amsterdam in September 1664 where Struyvesant captivated. Delaware did not fall until the following month when Sir Robert Carr stormed Fort Casinis (Hawke 1966; Billington 1960).

After the British conquest of Dutch possessions in America, Charles II granted those lands to his younger brother, the Duke of York. York in turn presented that portion between the Hudson and Delaware Rivers as the Colony of New Jersey to his friends Lord John Berkeley and Sir George Carteret. In 1674 Berkeley sold his share to two Quakers, John Fenwick and Edward Byllynge. When Fenwick and Byllynge began to feud over their purchase, William Penn was asked to arbitrate the dispute. Penn became a trustee of the lands relinquished by Byllynge, and in 1676 succeeded in obtaining a division of New Jersey whereby Carteret kept East Jersey and the Quakers West Jersey which bordered on the Delaware River and Bay. The Quakers began to govern West Jersey with a progressive consitution drafted by William Penn; Fenwick attempted, however, to develop his land as though it were a separate colony. East Jersey held its own assembly. Political matters were further complicated when the Governor of New York refused to recognize New Jersey's sovereignty. Litigation over land [illegible] continued throughout the colonial period, and differences

between East and West Jersey were unresolved, even after the colony possession from proprietary to royal political control in 1702 (Newberry 1977; Hawkes 1966).

English settlement of West Jersey began during the politically turbulent years of the late seventeenth century. When Edward Byllvnge died in 1687, his right of government passed to the Anglican Dr. Daniel Cox, who apparently built a residence more than four miles north of Cape May Point on the Delaware Bay side near Town Bank (Nash 1968). Cox sold his share of West Jersey in 1692 to a joint stock company of English merchants intent upon the promotion of ship building and whaling. Residents of the southern portion of West Jersey were primarily occupied with cattle grazing and farming during the 1700s, though they occasionally fished, whaled, and provided other boating services as ferrymen and pilots.

Because of its strategic location between New York City and Philadelphia, New Jersey was an important theatre of war during the American Revolution. Washington's victories at Trenton and Princeton during the winter of 1776-77 marked a turning point in America's battle for independence. Statehood was attained in 1787, the same year that New Jersev ratified the constitution (Alden 1954; Newberry 1977).

William Penn relinquished his trusteeship of West Jersey in 1681, the year that he received the charter to Pennsylvania from Charles II in return for debts which the King owned Penn's father. Penn issued a Frame of Government, publicized his colonizing venture in the British Isles and on the Continent, and set sail for his proprietary in 1682. That fall he landed in Upland, now Chester, Pennsylvania and called a general court which passed a declaration of liberty of conscience. Within two years 7,000 Welshman, German Quakers and Irish had emigrated to Pennsylvania. Nearly one third of them settled in Philadelphia, a city designed by Penn with a checkerboard layout so that the "streets may be uniform down to the water "of the Delaware" where it is most navigable." Penn had chosen his capital well; located on a major waterway it prospered, first from the fur trade, and later from agricultural produce which reached it from the rich lands along the Delaware. As early as 1700, Philadelphia rivaled Boston in commerce, and on the eve of the Revolution, Penn's capital had become the second largest city in the British empire (Nash 1968; Hawke 1966).

To protect Pennsylvania's avenue of commerce to the sea, Penn in 1682 received from the Duke of York a grant of land along the western shore of Delaware Bay from the southern boundary of Pennsylvania to Cape Henlopen. These three lower counties, as Delaware was called throughout the colonial era,

were governed as part of Pennsylvania until 1704. At that time, discontent over lack of military protection and lack of responsive representation led to the creation of a separate assembly at New Castle. The Lower Counties profited from the production of tobacco until around 1730 and thereafter from the cultivation of wheat. After fighting in the American Revolution as a separate political entity, Delaware became the first state to ratify tne Constitution (Scharf 1888; Wise 1978). The prosperity of the Delaware River and Bay has continued to expand since the close of the American Revolution. Wilmington became a major center for milling flour in the 1780s after the development of new mill machinerv bv Oliver Evans. The earliest paved roads extended from Philadelphia to Lancaster in 1794. The Du Pont powder mills were established on the Brandywine south of Wilmington in 1802. The Chesapeake and Delaware Canal was begun in 1803. The Schuylkill Canal linked Philadelphia and Reading in 1825,by which time steam boats had begun to ply the Delaware. A railroad network was begun during the following decades, and the concentration of economic infrastructure has been such that century land use along the Delaware from Trenton to Wilmington has become almost entirely urban (Hoffecker 1976; Taylor 1951; Newberry 1977).

Inventory of Protected Historic Sites

The following inventory has been based upon an extensive examination of the Historic Sites Inventories at the Pennsylvania, Delaware, and New Jersey State Historic Preservation Offices. At each state Preservation Office the Commonwealth project team mapped and prepared an abstracted statement of significance for each National Register status site or district which was located within one mile of the Delaware River and its tidal tributaries as specified in the regional spoil disposal plan. Additional sites were recorded at the suggestion of the respective Preservation Office staffs. The sites recorded were those listed in the National Register of Historic Places and those nominations which have been approved by the State Historic Preservation Review Boards as of December 1978 but whose designation is pending approval by the U.S. Department of the Interior. New Jersey State Register of Historic Places sites have also been recorded because the New Jersey Register law of 1970 protects those sites from publicly funded undertakings; Pennsylvania and Delaware do not have comparable legislation (New Jersey Register n.d.).

In Pennsylvania and Delaware the State Preservation Office site designation numbers were utilized, as were the Inventory site abstracts. The Commonwealth project team arbitrarily assigned site numbers for the New Jersey sites because that state has no mapping system for register properties. The abstracts of significance for all New Jersey

sites were prepared directly from the historic site nomination files; the same procedure was followed in Pennsylvania and Delaware for the more recently designated sites which have not yet been abstracted in their respective Inventories.

The Inventory of Protected Historic Sites presents information on each registered property in the following format:

1. Site Letters and Numbers

   a. the first letter identifies the state in which the site is located

      P = Pennsylvania

      D = Delaware

      N = New Jersey

   b. the second letter identifies the county in which the site is located

      Pennsylvania:

         B = Bucks County

         P = Philadelphia County

         D = Delaware County

      Delaware:

         N = New Castle County

         K = Kent County

         S = Sussex County

      New Jersey

         M = Mercer County

         B = Burlington County

Ca = Camden County

G = Gloucester County

S = Salem County

Cu = Cumberland County

Cy = Cape May County

c. site numbers have been assigned to each within a given county. As stated above, the Pennsylvania and Delaware site numbers are those used in their respective registered site mapping systems; the Commonwealth project team has arbitrarily assigned site numbers to the New Jersey registered properties

2. Site Name

3. Site Address

4. Date of Construction

a succession of dates indicates times of structural alteration; events of associational significance; or periods of construction for historic districts

5. Abstract of Significance

6. Designation

a. Nat Reg = listed in National Register of Historic Places

b. Nat Reg pending = approved by State Historic Preservation Review Board but not yet approved by U.S. Department of Interior

c. NHL = listed as a National Historic Landmark; all such properties are automatically listed in the National Register of Historic Places

d. HABS = recorded by the Historic American Buildings Survey

e. HAER = documented by the Historic American Engineering Record

f. State Register = listed in the New Jersey Register of Historic Places.

Sites are grouped by state and county and are listed from north to south in order of their location along the Delaware River and Bay and its tidal tributaries. The site letters and numbers are portrayed in the same sequence on the margins of the three maps in Figure 2; Pennsylvania and Delaware sites are placed on the left side map margins, and New Jersey sites are placed on the right side map margins. Actual site locations are also shown by site letters and numbers in Figure 2.

Pennsylvania

Bucks County

PB 20 Delaware Canal

Parallels west bank of Delaware River from Easton to Bristol (1837). Completed in 1837, the 60 mile Delaware Canal ran from Bristol to Easton. It had 23 lift locks and nine aquaducts. The canal served as a major shipping route for the northeastern coal fields. It also comprises a portion of Theodore Roosevelt State Park. NHL.

PB 22 Calhoun Street Bridge

Bridge across the Delaware between Morrisville, Pennsylvania and Trenton, New Jersey (1885). Well preserved "Phoenix Iron Bridge" at Morrisville. Constructed in Phoenixville, Pennsylvania, it is one of the longest bridges of this type extant in the state. Seven spans of 180', constructed of wrought iron rolled in semi-circular sections and riveted together - subsequently known as the Phoenix Column. This column was designed and patented by Wendell Bollman. Nat. Reg., HAER.

PB 11 Summerseat

Clymer Street at Morris Avenue, Morrisville (c. 1770) two and a half story brick, gable roof

Georgian structure, the home of George Clymer, a signer of the Declaration of Independence. Five bays across, two rooms deep with a pent eave. NHL.

PB 10 Pennsbury Manor

South of Bordentown, near USI and 13, Falls Township (1682 and 1939). A one and a half story, brick reconstruction of William Penn's home. This reconstruction, based on Penn's correspondence, was constructed in 1939. Nat. Reg.

PB 01 Andalusia (Nicholas Biddle Estate)

Pa32 1.4 miles north of Philadelphia, Bensalem Township (late eighteenth century). Two and a half story Greek Revival building constructed at site of an earlier structure. Nicholas Biddle politician and financier of the Revolution designed the classical motif and lived here. NHL.

PB 28 St. Elizabeth's Convent (Sisters of the Blessed Scarament)

Bristol Pike, Bensalem Township (late nineteenth century). Designed by Charles Burns in the late nineteenth century, these gray stone, tile roofed buildings were constructed for Katherine Drexel who founded the "Sisters of the Blessed Sacrament for Indians and Colored People." The order has grown and by 1955 had placed teachers in 22 states. Nat. Reg.

Philadelphia County

PP 32 Frankford Arsenal

Tacony and Bridge Streets, Philadelphia (1830). Initiated in 1816 as a munitions depot, the complex originally contained six stone buildings and two small workshops. It has been greatly expanded and still serves as a major center for the development of military weapons. Nat Reg.

PP 63 USS Olympia

Pier 40 at foot of Chestnut Street, Philadelphia (1888). The cruiser Olympia is the oldest steel-hulled American warship afloat. Seved as Commodore George Dewey's flagship in the Battle of Manila Bay during the Spanish American War. NHL.

PP 130 USS Becuna

Perris Landing, Delaware and Spruce, Philadelphia (1944). A World War II fleet submarine commissioned in 1944, served as submarine flagship of the Pacific fleet under command of General Douglas MacArthur. Used by the Navy from 1944 to 1969. Ship is 309 feet long, 27 feet wide with a weight of 1,526 tons. Nat. Reg.

PP 40 Woodlands (William Hamilton House)

40th Street and Woodland Avenue, Philadelphia (c. 1742, 1770). Two and a half story stone, hip

roofed, late Georgian house with round head and Palledian window and a six column portico. The Country house of William Hamilton, son of Andrew Hamilton who defended Peter Zengen William lived there until his death in 1813 and took an active interest in landscaping the grounds. In 1839 the house and 91 acres of land were incorporated into the Woodland's Cemetery; the property still serves this function. NHL; HABS.

PP 75 Society Hill Historical District

Walnut Street to Lombard Street to Delaware River to 8th Street Philadelphia (eighteenth- nineteenth century). The oldest portion of Philadelphia contains more than 575 eighteenth and nineteenth and commercial residential, and religious structures. Most of the early residences are brick with wood trim, and belt courses. Nat. Reg., HABS.

PP 77 Southwark District (Wiaco)

5th Street tc Washington Street to Delaware River to Lombard Street, Philadelphia (eighteenth and nineteenth century). Originally an independent borough called Wicaco by the Swedes who lived there, Southward was the center of Philadelphia maritime activity during the eighteenth century and served as a home for mariners. Houses of brick, two and a half stories high, with gable roofs, chimneys, and dormers. Nat.

PP 38 Gloria Dei Church (Old Swedes Church)

Swanson Street, between Christian and Water Streets, Philadelphia (1698-1700). Gloria Dei was built for the Swedish Lutheran congregation at Wicaco. Philadelphia's oldest church, constructed of brick with a steep roof, several gables, square belfry, and a small spire. Nat. Reg., HABS.

PP 06 John Bartram House and Gardens

54th Street and Elmwood on the Schurylkill River, Philadelphia (1731). Two and a half story stone house built in 1731 by noted botanist John Bartram. Located on 26 acres of land which comprise Bartram's botanical gardens. NHL, HABS.

PP 72 Commandant's Quarters (Quarters "A")

U.S. Naval Base, Philadelphia (1875). Three-story brick building with slate roof, constructed on League Island which was deeded to the United States by the City of Philadelphia in 1868. Quarters A is slated for conversion into a permanent Naval Historical Museum which will depict the development of the U.S. Navy. Nat. Reg.

PP 109 Marine Barracks

U.S. Naval Base, Philadelphia (c. 1900). Located on League Island (see Commandant's Quarters), the first permanent building was constructed in 1901 at a cost of $95,000. Unmodified since its construction, the Barracks is a four story building of red brick and gypsum block construction. Nat. Reg.

PP 30 Ft. Mufflin (Old Fort Mufflin)

Southwest corner of 5th and Chestnut Streets, Philadelphia (pre 1777). Laid out in 1771 by Englishman John Montressor, the fort's completion was interrupted by the American Revolution. Captured by the British the fort was reconstructed of stone in 1798 by Pierre Charles l'Eufaut. NHL, HABS.

PP 31 Ft. Mifflin Hospital (Old Fort Mifflin Hospital)

Marine and Penrose Ferry Roads, Philadelphia (nineteenth century). The hospital was built after the Battle of Fort Mifflin. It served as a hospital and prison for Confederate troops captured during the Civil War. Nat. Reg.,HABS.

Delaware County

PD 37 Old Drain and the Chemistry Building

14th Street between Melrose Avenue and Walnut Street, Chester (1867). Designed by John Crump for a

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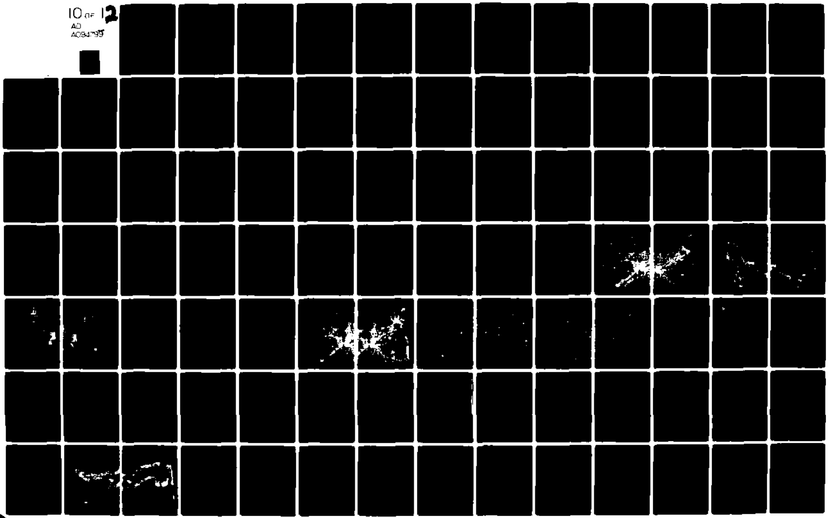

military institute of 350 cadets; subsequently known as Pennsylvania Military Academy and the Pennsylvania Military College, now known as Widener College. Four and a half story structure of stucco with a stone ground story and gable dormers. Central bay topped by a sixth story pediment. Pending Nat. Reg.

PD 27 Old Main

21st Street and Upland Avenue, Upland (1858). A large three story building with three connected, pedimented pavilions. Begun as a boys school, the building served as a hospital for Union and Confederate wounded during the Civil War. Nat. Reg.

PD 17 Chester Courthouse

Market Street below 5th Street, Chester (1724-44). A two and a half story building with a small square cupola. A three-sided bay addition with large windows was added in 1744. One of the oldest public buildings in the nation. Nat. Reg.

PD 19 Penn Landing Site

Penn and Front Streets, Chester (1682). A granite stone with inscriptions which marks the spot where William Penn landed, October 1682. Nat. Reg.

PD 21 Printzhof

Taylor Avenue and 2nd Street, Essington (c. 1643). Site of earliest permanent European settlement in Pennsylvania. Excavations of the Swedish settlement of New Gothenburg have uncovered foundations of Governor Johan Printz, house as well as numerous artifacts. NHL.

PD 11 Lazaretto

Wanamaker Avenue at 2nd Street, Essington (nineteenth century). Three-story, hipped roof, Georgian structure with cupola and long flanking wings. Built as a quarantine station for sick immigrants; served as hospital until 1880. Nat. Reg.

PD 28 Crozer Manison

6th Street, Upland (1867). Large two-story stone house designed in Italinate Style with three-story tower and elaborate interiors; the home of a wealthy textile manufacturing family. Nat. Reg.

PD 22 Pusey House

15 Race Street and Landingford Plantation, Upland (1683, 1696) Originally a one and a half story gambrel roof stone house with one ground floor room. A gable roof extension was constructed C.1696. One of the earliest English built houses in America. Nat. Reg.; HABS.

PD 30 Pusey-Crozier Mill Historical District

Race Street, Upland (seventeenth - nineteenth century). A district along Chester Creek which encompasses the Pusey House and a three-story, plastered stone textile mill. Nat. Reg.

Delaware

New Castle County

DN 450 Robinson House (Naaman's)

Naaman's Corner, Claymont (c. 1770). An additive residence consisting of a frame and masonry portion and a stone wing to the rear constructed by General Thomas Robinson, aide to Anthony Wayne during the Revolutionary War. Nat. Reg.; HABS.

DN 157 Mendenhall House

205 East Front Street, Wilmington (c. 1780). A large residence built prior to 1790 by Thomas Mendenhall who sailed in the Caribbean and to the British Isles. He prospered by this trade and served as an assistant burgess in 1795 and a commissioner of the Levy Court in 1801 and 1818. Nat. Reg., HABS.

DN 874 Friends Meeting House

4th and West Streets, Wilmington (1817). Built in 1817 on the site of an 1748 meeting house, the

present structure remains in religious ownership and in its cemetery are buried Governors John Dickinson, and Caleb Prew Bennett, abolitionist Thomas Garrett, and journalist Hezekiah Niles. Nat. Reg.

DN 340 Holy Trinity (Old Swedes) Cnurch

Between Church Street, 7th Street, and Church Lane, Wilmington (1699). A stone church with brick trim begun in 1698 and dedicated in 1699. Built by the Swedish Lutherans at the site of a burial place in use since 1638, repaired in 1842, and restored in 1898, this is thought to be one of America's oldest churches which is still used for services. NHL; HABS.

DN 388 Fort Christina

Foot of 7th Street, Wilmington (1638). Site of the landing of a Swedish expedition commanded by Peter Minuit. The Swedes established their settlement in 1638, and built a fort which they called Christina in honor of the Queen of Sweden. This became the first permanent settlement in the Delaware River Valley. NHL.

DN 174 Old Ashbury Methodist Church

3rd and Walnut Streets, Wilimington (1789). Thirty-five feet square when completed in 1789, the church has since undergone extensive alterations. Nat. Reg.; HABS.

DN 051 St. Mary's Church

6th and Pine Streets, Wilmington (1858). A brick church constructed in 1858, the only catholic church in Delaware erected during the espicopate of Bishop John H. Neumann. The central tower was added in 1881. Nat. Reg.

DN 3637 Harland and Hollingsworth Office Building

Foot of West Street, Wilmington (c. 1900). A three-story brick flemish bond structure built in Georgian Revival style for one of the oldest and most important shipbuilding companies in the country. Pending Nat. Reg.

DN 4018 "State of Pennsylvania"

Partially submerged Christiana River at foot of Madison Street, Wilmington (1923). A ship 219' long, 49' beam, 10 1/2' draft; built in 1923, modified 1944; one of the largest single screw river steamers; foundered in 1970. Pending Nat. Reg.

DN 1423 Woodstock

102 Middleboro Road, Wilmington (eighteenth Century). The only remaining plantation property along the Christina River. Owned by Swede Andries Andriessen in the mid seventeenth century, the land passed into the hands of John Richardson in 1687; Richardson's son, John II, leved there after 1704 and built a home at the present site of Woodstock. Nat. Reg.

DN 246 Hale-Byrnes House

Corner DE 7 and 4, Stanton vicinity (1750). A structure whose brick wing dates from 1750 and was built for Samuel Hale, a potter; Daniel Byrnes, a miller, added the north wing after his purchase of the property in 1772. In 1772 General George Washington held a council of war in the house. Nat Reg.; HABS.

DN 403 Swanwyck

65 Landers Lane, Swanwyck (c. 1850). An excellent example of Regency architecture designed prior to the Civil War by Peter Bandy who also prepared the plans for Wilmington's Town Hall. Nat. Reg., HABS.

DN 386 Glebe House

Del #9, near New Castle (c. 1825). A brick house built in three sections and occupied by the rector of Immanuel Church. Nat. Reg.; HABS.

DN 399 The Hermitage

Del. #273, near New Castle (1801-1818). Built between 1801 and 1818 by Nicholas Van Dyke who served in the Delaware House of Representatives and in the U.S. Senate. Nat. Reg.;HABS.

DN 362 Stonum

9th and Washington Streets, New Castle (1730, 1750. Built in 1730 and 1750, this house was owned by George Read I, a signer of the Declaration of Independence, and Kensey Johns, Chief Justice of Delaware. NHL; HABS.

DN 1475 Christina Historic District

Junction of DE 7 and 273 (1760s-1820s). Located at the head of navigation on the Christina River and on the main highway between Philadelphia and Baltimore, Christina prospered during the Revolutionary Era. The village became an important grain shipping port and contained 36 structures by 1816. The town's economic decline began with completion of Chesapeake and Delaware Canal in 1829. Nat. Reg.

DN 385 Lesley-Travers Mansion

112 West 6th Street, New Castle (1855). A brick house with pine structural members; designed in Gothic style by Baltimore architects Thomas and James Dixon for Dr. Allen Voorhees Lesley. Nat. Reg.

DN 1290 Old New Castle Court House

Delaware Avenue at the Green, New Castle (1732, 1765, 1845). Built in four sections, the central part was completed in 1732; two wings were added in 1765; one of these was replaced in 1845, and the entire structure was restored in the 1950's. The structure housed the Delaware General Assembly until 1777, and the Declaration of Independence was approved there in 1776. NHL; HABS.

DN 349 New Castle Historic District

The Strand, Delaware Avenue, 3rd Avenue, Harmony Street, New Castle (1651-nineteenth century). Founded by the Dutch in 1651, New Castle was Delaware's first town, the meeting place of all colonial assemblies and the first state capital. NHL; HABS.

DN 1306 Amstel House

4th and Delaware Streets, New Castle (1730). The present structure, built for Dr. John Finney, around 1730, probably incorporates portion of an earlier structure. The house was subsequently occupied in the eighteenth century by Delaware Governor Nicholas Van Dyke. Nat. Reg.; HABS.

DN 219 Buena Vista

U.S. #13, south of Wilmington (1845-1847). A five-bay, two-story brick structure with six Doric columns and cast iron balustrade, built c. 1845 in the Greek Revivial style for John M. Clayton, U.S. Senator and Secretary of State under President Zackary Taylor. Nat. Reg.; HABS.

DN 145 Fort Delaware

On Pea Patch Island in Delaware River, Delaware City vicinity (c. 1850). A pre-Civil Ware five-sided fort with walls of solid granite 7 to 30 feet thick surrounded by a moat 30 feet wide. Nat. Reg.; HABS.

DN 1559 Eastern Lock of the Chesapeake and Delaware Canal

Buttery Park, Delaware City (c. 1829). The stone walled lock provided access for ships between the river and the canal, near the lock is an iron diving bell used to make repairs on the lock gates. Nat. Reg.

DN 144 Sutton House

Broad and Delaware Streets, St. Georges (1792, 1815). A brick townhouse built for John Sutton, one of St. George's earliest residents and for many years her only merchant. Nat. Reg.

DN 3935 Biddle House

East of U.S. 13, 2 miles south of C and D Canal (c. 1790-c. 1850). Begun as a late nineteenth century one room dwelling of sawn plank; early nineteenth century federal two-story, three bay expansion; additions in mid-nineteenth century with later Victorian wings. The resident of two intermarried farm families, the Vandergrifts and Biddles. Nat.Reg. pending.

DN 3932 Ashton Historic District

Approximately 1 mile north of Port Penn (c. 1750). A complex comprised of three mid-eighteenth century residences of Georgian style; the structures were associated with Robert Ashton who was a significant figure in the early development of New Castle County. Nat. Reg.

DN 1623 Liston Range Rear Light Station

One half mile east of U.S. 13; approximately 2 miles south of C and D Canal (c. 1880). A light station with all appurtenances. Built of wrought iron, this light tower has been in continuous use since the last quarter of the nineteenth century. Nat. Reg.; HAER.

DN 3928 Port Penn Historic District

Port Penn (c. 1850). Port Penn was a center for Delaware's peach industry which prospered during the nineteenth century. The district contains approximately 75 properties, most of which are well preserved nineteenth century residences. Nat. Reg. pending.

DN 147 Dilworth House

Port Penn (c. 1680; eighteenth century, late nineteenth century). A three-Bay wide west section

built in brick after 1679 when property was conveyed to Olla Jansen; three-bay east portion of brick added during eighteenth century; frame section added late in the nineteenth century. Nat. Reg.

DN 148 Hazel Glen

Approximately 2 miles east of Port Penn (1845). House with narrow main block, one room deep, designed in Italianate style with Greek Revival details. Nat. Reg.

DN 150 Augustine Beach Hotel

Port Penn vicinity, south on DE 9 (1814). Built in 1814, and named for Augustine Herrman, this hotel catered to vacationers who arrived via steamboat from Wilmington. Nat. Reg.

DN 424 Macdonough House

McDonough and U.S. 13 (c. 1800). The home of Commodore Thomas Macdonough who defeated the British on Lake Champlain during the War of 1812. Nat. Reg. pending.

DN 154 Old Drawyers Church

U.S. Route 13, Odessa (c. 1770). A Presbyterian Church built around 1770 and renowned as an outstanding example of Georgian ecclesiastical

architecture; one of several rural Delaware churches preserved after their congregations built town churches during the mid-nineteenth century. Nat. Reg.;HABS.

DN 416 Appoquinimink Friends Meeting House

Main Street Odessa (1785). A small religious structure used by the Society of Friends from its construction in 1785 until around 1881; since 1951 the meeting house has been used by a group of local friends. Nat. Reg., HABS.

DN 126 Odessa Historic District

Appoguinimink Creek, High Street, 4th Street, Main Street, Odessa (eighteenth and nineteenth century). The district contains well preserved eighteenth century houses and nineteenth century commercial buildings. Nat. Reg.

DN 125 Corbit-Sharp House

Main Street, Odessa (1772-4). A five-bay, two-story brick dwelling with hipped roof and unusual cornice, built in 1772-74 by Robert May for William Corbit, a Tanner Georgian Style. Nat. Reg.,HABS.

DN 152 Hart House

East of Taylors Bridge on DE 453 (1725). A simple three-bay house of brick laid in Flemish bond; the structure was looted by Spanish forces during the War of Jenkins' Ear, 1739-1742. Nat. Reg.

DN 151 Liston House

East of Taylors Bridge on DE 453 (1739). A gambrel roof brick house located near the water's edge on Thoroughfare Neck. Like the Hart House,it was plundered during the 1740s. Nat. Reg.

DN 419 Hugenot House

Del #9 Taylor's Bridge (c. 1730). Originally a three-bay, side-hall brick dwelling, another bay and a smaller brick and frame wing were added after the initial construction. House still in possession of descendants from original owner Elias Naudain. Nat. Reg., HABS.

DN 423 Old Union Methodist Church

North of Blackbird Crossroads on U.S. 13 (1847). An unornamented brick church built in 1847 by a congregation which had worshipped there since 1789. Nat. Reg.

Kent County

DK 133 Sutton House

Woodland Beach vicinity, DE 79 (eighteenth century). A two-story three-bay, hall and parlor house whose eighteenth century interior detail has been well preserved. Nat. Reg.

DK 101 Allee House

Dutch Neck crossroads vicinity off Del. 9. (c. 1765). A two-story, three-bay center hall, brick structure typical of rural Delaware architecture for the period. Nat. Reg.

DK 131 Ruth Mansion House

Main Street, Leipsic (c. 1780). A five-bay two-story, brick house of Flemish bond, the home of William Ruth who served as one of the trustees for the Kent County free school established by the 1796 charity school law. Nat. Reg.; HABS.

DK 132 Snowland

Leipsic DE 42 (Late eighteenth century). Originally a three-bay two-story brick house, later enlarged to five bays with an asymmetrical facade. The home of Andrew Naudain whose son, Arnold was a major in the War of 1812, Dover postmaster, Delaware and U. S. Senator, and twice president of the Delaware Medical Society. Nat. Reg.; HABS.

DK 136 Wheel of Fortune

DE 9 South of Leipsic (Late eighteenth century). A center hall plan house, one room deep, constructed of brick with a Flemish bond facade which is spanned by a box cornice with molded trim. Nat. Reg.; HABS.

DK 114 Octagonal Schoolhouse

Del #9, south of Cowgill's Corner (c. 1830). An octagonal stone structure built soon after passage of the first free school law in Delaware in 1829. Nat. Reg., HABS.

DK 321 Macomb Farm

South side of Long Point Road, Dover (late eighteenth century). A brick two-story structure with a glazed header Flemish bond facade. Built by Judge Thomas Irons whose son occupied the house and farmed its land until his death in the nineteenth century. Nat. Reg.

DK 130 Old Stone Tavern

Main Street, Little Creek (c. 1825). Built of unusual materials for a county devoid of native stone, the structure was reportedly designed by Manlove Hayes, Sr; interior details reflect the influence of Asher Benjamin. Nat. Reg.

DK 149 Tyn Head Court

East of Dover on South Little Creek Road (eighteenth century). A three-bay, gambrel roof structure owned by James Sykes, a delegate to the Continental Congress, and a member of the Delaware Constitutional Convention of 1792. Nat Reg.

DK 862 Cherbourg Round Barn

West of Little River, South of DE 8 (1918). Unique to Delaware, a round barn with wooden timbering and a poured concrete foundation and walls. Nat. Reg. pending.

DK 108 Dickinson Mansion

Kitt Hummock Road (1740). A two-story bind mansion with main section completed in 1740; the childhood home of John Dickinson who presided over the Annapolis Convention which called for the Federal Constitutional Convention. Nat. Reg. HABS.

DK 117 Town Point (Kingston-Upon-Hull)

Kitts Hummock Road Dover vicinity (c. 1675). A two-story residence with brick ground story and frame upper story. Originally a one-story structure, the Flemish bond edifice was the dwelling of Edward

Pack. Sometime after 1687 Pack sold the house to William Darvall; both men were magistrates, and in this structure were held the first courts for what would become Kent County. Nat. Reg.

DK 113 Lowber House

East of Main Street, US113A, Magnolia (1774). A two-story brick, hall and parlor structure built in 1774 with later frame wings. The brick work features a Flemish bond facade and ornamental brick lintels. Nat. Reg.

DK 137 Reed House

U.S. 113 and DE 8, Little Heaven (1771, 1868). Originally a three-bay, two-story house featuring Flemish bond brick work, built in 1771; enlarged in 1868 to its present five-bay, three dimensions by John Reed who was among the earliest Kent County farmers to introduce budded peach trees. Nat. Reg.

DK 121 Barratt Hall

East of U.S. 113, Frederica vicinity (c. 1750). A brick farm house constructed in the mid-eighteenth century, the home of Philip Barratt where in 1784 Bishops Coke and Asbury met with 11 ministers to plan the separate establishment of the Methodist Episcopal Church. Nat. Reg.

DK 103 Barratt's Chapel

North of Frederica on U.S. 113 (1780). A large brick meeting place which housed gatherings that led to the establishment of the Methodist Church as a separate denomination in America. HABS; Nat. Reg.

DK 123 Bonwell House

North of Frederica on DE 380 (late eighteenth century). A two story, hall and parlor, brick house with a dentil cornice and stone lintel blocks. Nat. Reg.

DK 322 Frederica Historic District

Market, Front and Davids Streets, Frederica (eighteenth-nineteenth century). A district with 121 residential and commercial structures dating from the mid-eighteenth to late nineteenth century. Frederica began as a crossroads settlement and a small shipping center for southern Kent County. Nat. Reg.

DK 129 Mordington

South of Frederica on Canterbury Road (c. 1790). A two story brick dwelling with side hall plan, built in late Georgian style for Walter Douglas, ironmaster and miller. Nat. Reg.; HABS.

DK 360 Wilkerson and Son Brick works

Approximately one mile East of Milford (c. 1900). An early twentieth century brick works in use until 1950; virtually all phases of this industrial operation are still intact. Nat. Reg.; HAER.

DK 244 Christ Church

3rd and Church Streets, Milford (1791, 1835, 1863, 1894). Begun in 1791, completed in 1835, altered in 1863 and 1894 to its present Gothic appearance. Nat. Reg.

DK 167 Bank House

119 North Walnut Street, Milford (1850). Converted from a bank building to a private residence, this brick structure survives as an example of Greek Revival architecture. Nat. Reg.

DK 116 Thorne Mansion

501 Northwest Front Street, Milford (mid- eighteenth century) a two-story brick dwelling with 1 1/2 story wings connected by covered walkways, the home of Sydenham Thorne, an Anglican minister and co-founder of Milford, A. William Burton, Governor of Delaware and John M. Clayton, Secretary of State under President Zachary Taylor. Nat. Reg.

Wise, Cara L.
1978 Early Historic settlement in Delaware, paper presented at the 1978 Middle Atlantic Archeological Conference.

October 1978 Settlement patterns and cultural resource management in the Delaware Experience, paper delivered at the Council on Northeast Archeology, Bear Mountain, New York.

Witthoft, John
1971 Broad spearpoints and the transitional period cultures. Pennsylvania prehistory. Anthropological Series No. 1, Pennsylvania Historical and Museum Commission.

Woolman, H.C.; T. F. Rose; and T. T. Price
1878 Historical and Biographical Atlas of the New Jersev Coast, Philadelphia.

DK 171 Golden Mine

Southeast of Houston, West of Milford (c. 1763). A three-bay, two door frame structure with cypress shingles built on land held by a succession of land companies. Nat. Reg.

Sussex County

DS 177 Abbott's Mill

West of Milford (1860s). Constructed of wood with iron turbines and shafts; one of Delaware's water powered grist mills. Nat. Reg.

DS 186 Delaware Breakwaters and Lewes Harbor

East of Lewes at Cape Herrlopen (1828-1835). The first breakwater of Brandywine granite was designed by William Strickland and constructed between 1828 and 1835. The breakwater forms a harbor of refuge where many ships have taken shelter from storms. Nat. Reg.; HAER.

DS 160 Russell Farmhouse

410 Pilot Town Road, Lewes (c. 1803). A three-bay, 1 1/2 story frame house built around 1803 for Wm. Russell, a tanner and large land holder. Nat. Reg.

DS 174 DeVries Palisade

Pilottown Road, Lewes (1631). The site of a Dutch stockade built in 1631 to protect a trading expedition backed by Captain David DeVries. When DeVries visited the colony in 1632 he discovered that the settlers had been killed by Indians. Nat. Reg.

DS 175 Maull House

Pilottown Road, Lewes (c. 1750). A gambrel roofed two-story, cypress shingled dwelling built around 1750; the house has recently been restored by the local DAR chapter. Nat. Reg.; HABS.

DS 140 Fisher's Paradise

624 Pilottown Road, Lewes (c. 1790). A three-bay, 2 1/2 story house built shortly after the Revolution by Major Henry Fisher who defended Cape Henlopen and the entrance to the Delaware Bay.

DS 314 Pagan Creek Dike

Pagan Creek near New Road, Lewes (seventeenth century). Abandoned since the eighteenth century, the dike was built by Dutch settlers to connect the West Indian Company fort with areas beyond Pagan Creek. The 700 foot long causeway, 9 to 10 feet wide, has changed little since its construction prior to 1670. Nat. Reg.; HAER.

DS 190 Hazzard House

Union Street, Milton (1790). A late eighteenth century hall and parlor house of frame construction built by John Hazzard, a son of Coard Hazzard who settled in the Broadkill Hundred in 1700. John's son, David, was a grain merchant who served as Governor of Delaware, 1830-3. Nat. Reg.

DS 139 Hall House

107 King's Highway, Lewes (1790). A three-bay, 2 1/2 story dwelling with cypress shingles built in 1790 by David Hall, a colonel in the Revolution and later Governor of Delaware. Nat. Reg.; HABS.

DS 142 Coleman House

422 King's Highway, Lewes (c.1780). A 2 1/2 story frame and cypress shingled residence erected around 1780 and characteristic of Sussex County's oldest surviving domestic architecture. Nat. Reg.; HABS.

DS 290 Lewes Historic District

Lewes (Late seventeenth-nineteenth century). The district contains the town plan laid out before 1680 but is presently distinguished primarily for its well preserved Victorian residences. Nat. Reg.; HAER.

DS 145 Lewes Presbyterian Church

King's Highway, Lewes (1832, 1887). A frame edifice topped by a spire, the church was completed in 1832 and remodeled in 1887. It is on the site of one of lower Delaware's first Presbyterian churches, erected in 1707. In its churchyard cemetery are buried two nineteenth century Delaware governors. Nat. Reg.

DS 291 Governor Ponder House

416 Federal Street, Milton (1871-1875). A five-bay, three-story frame and clapboard house with a slate covered Mansard roof built 1871-75 by James Ponder during his term as Governor of Delaware. Nat. Reg.

DS 292 Draper-Adkins House

204 Federal Street, Milton (c. 1840). A 2 1/2 story five-bay frame and clapboard residence built circa 1840 in the Greek Revival style for Captain Joseph Adkins who engaged in Delaware's maritime trade. Nat. Reg.

DS 137 Fisher House

Near Cool Spring (c. 1720). A frame dwelling built between 1700 and 1736 on a tract owned by

Thomas Fisher; Thomas' son Joshua, a merchant, sold the house and land to James Martin in 1736. Nat. Reg.; HABS.

DS 155 Marsh House

10 Dood's Lane, Rehoboth Beach (1742). A two-story frame dwelling with cypress shingles built by yeoman Peter Marsh in 1742. Nat. Reg.; HABS.

DS 152 St. George's Chapel

Chapel Branch North of Hollymount (1794). A brick church erected in Georgian style as an Episcopalian house of worship; extensively restored. Nat. Reg.

New Jersey

Mercer County

NM 01 Mansion House (McCall House)

Cadwalader Park, Trenton (1846). A two-story Itlianate Villa with a three-story tower, built of brick and covered with stucco scored to resemble stone. Originally the home of Henry McCall, a wealthy Philadelphia merchant with Trenton business interests. Nat. Reg.

NM 02 Dickinson House (Hermitage)

46 Colonial Avenue, Trenton (1784). A large two-story house with low hipped roof and stone walls covered with stucco, built in 1784 as the home of Philemon Dickinson, Commander of the New Jersey Militia during the Revolution.

NM 03 Trenton Battle Monument

Warren and Broad Streets, Trenton (1894). A 150 foot granite column topped by a statue carved by R. O. Donovan. Erected between 1891 and 1893, the monument commemorates Washington's triumph at the Battle of Trenton. Nat. Reg.

NM 04 Trenton City Hall

309 East State Street, Trenton (1907). A three-story structure faced with white Vermont marble, designed by Spencer Roberts; the building features a second floor mural painted by Everett Shinn, one of the five original "Ashcan School" painters. Nat. Reg.

NM 05 Old Barracks

South Willow Street, Trenton (1758). Erected in 1758-1759, Hessian troops were quartered in the 2-1/2 story U-plan stone structure when Washington captured the 1000-man garrison in the first battle of Trenton. NHL.

NM 06 State House Historic District

State and Willow Streets, Trenton (nineteenth century). District consists of late Federal clapboard

houses, Greek Revival and later nineteenth century row houses and the State House, begun in 1792, with additions in 1848, 1889, 1891, 1902, 1906. Nat. Reg.; HABS.

NM 07 Mercer Street Friends Center

151 Mercer Street, Trenton (1858). A three-bay 1-1/2 story structure with gable and chimneys, built of brick in 1858 as a meeting house for the Society of Friends. Nat. Reg.

NM 08 Mill Hill Historic District

East Front Street, Clay Street, Greenwood Street, S. Broad Street and Jackson Street, Trenton (nineteenth century). A mixture of nineteenth century commercial and residential buildings and open parkland. Nat. Reg.

NM 09 Douglass House (Bright House)

Front and Montgomery Streets, Trenton (1766). A 2-1/2 story frame building with beaded siding where General Washington held a council of war prior to the second Battle of Trenton; moved. Nat. Reg.

NM 10 Trent House

539 South Warren Street, Trenton (1719). A five-bay, two-story brick residence with a central main facade entrance and a central cupola; constructed in 1719 for William Trent who became Chief Justice of New Jersey. The house subsequently served as the residence for several state governors. NHL.

NM 11 Eagle Tavern

431-3 South Broad Street and Ferry, Trenton (c. 1765, 1817). 2-1/2 story brick structure with gable roof dormers, probably first served as residence for manager of nearby grist mills; by 1817 recorded as the Eagle Hotel. Trenton's oldest commercial structure. Nat. Reg.

NM 12 Abbott Farm Archeological Site and Historic District

South of Trenton, north of Bordentown. A large archeological site where Charles Conrad Abbott, M.D. in 1872 reported finding man-made implements in the Trenton glacial gravels on his farm. Dr. Abbott's report initiated a major controversy over the existence of glacial man in the New World which continued for 40 years. NHL.

NM 13 Bow Hill (DeKlyn House)

Jeremiah Avenue off Labor Street, Trenton (eighteenth century). A five-bay, 2 1/2 story, brick residence of Federal style, built in 1790 by the deKlyn family. Barnt deKlyn was a French Hugenot merchant who made a fortune during the Revolutionarv War. Nat. Reg.

NM 14 Watson, Issac House

151 Westcott Avenue, Hamilton Township (c. 1710). A two story stone house with steeply pitched roof, small window openings and pent eaves; built around 1710 by Isaac Watson, a farmer, surveyor, constable, and Overseer of Highways. The house features a heavy bowed timer A-frame construction. Nat. Reg.

NM 15 Abbot-DeCore Mansion

58 Soloff Drive, Trenton Vicinity (1797). A two-story, five-bay, brick residence of Georgian design, built by Samuel Abbott and purchased in 1888 by the DeCou family. Nat. Reg.

Burlington County

NB 01 Point Breeze Historic District

Route 206 and Park Street, Bordentown (nineteenth century). A 165-acre estate which contains the site of Joseph Bonapart mansion built in 1817, and an extant two-story three-bay hip roofed house, and a large Italianate mansion constructed in 1850. Nat. Reg.

NB 02 Hopkinson, Francis House

101 Farnsworth Avenue, Bordentown (1750). A two and a half story L-plan brick residence built

in 1750 for merchant John Imlay and subsequently the residence of Francis Hopkinson, lawyer, judge, poet and signer of the Declaration of Independence. NHL, HABS.

NB 03 Bordentown Historic District

Portions of 2nd and 3rd Streets, Bordentown (1800-1900). A mixed residential and commercial district which encompasses much of the town and includes buildings dating from the late eighteenth century to the present. State Register.

NB 04 Roebling Historic District

Riverside and Hornberger Avenues 2nd and 8th Streets, Roebling (1905). A residential and commercial district contiguous to the Roebling Steel Mill and wire rope factory. Roebling was founded in 1904 and built the following year. Nat. Reg.

NB 05 Quaker School

York and Penn Streets, Burlington (c. 1792). A 1-1/2 story brick structure built to house the Society of Friends school whose first classes were recorded in 1705. Nat. Reg.

NB 06 Burlington Historic District

West Delaware, Wood, and Broad Streets, Burlington (seventeenth-nineteenth century). The district contains residential, religious and educational buildings, two of late seventeenth century-early eighteenth century construction. Most structures date from the late eighteenth through the nineteenth century. Nat. Reg.; HABS.

NB 07 St. Mary's Episcopal Church

West Broad and Wood Streets, Burlington (1846). Designed by Richard Upjohn, in Gothic style. Constructed of stone, cruciform in plan with a tower and spire, begun in 1846 and completed in 1854. Nat. Reg.; HABS.

NB 08 Pearson-How, Cooper, Lawrence Houses

453-9 High Street, Burlington (eighteenth century). These well preserved residences are examples of eighteenth century two-story, gable roofed structures whose long, main facades front on Lawrence Street. Their colonial residents were members of the General Assembly; judges and lawyers. James Fenimore Cooper was born in one of these houses in 1789. Nat. Reg.; HABS.

NB 09 Coopertown Meetinghouse

Cooper Street at Route 130, Edgewater Park (1806). A one-story, three-bay structure of brick on a fieldstone foundation, used as a meeting house by Methodists, Episcopalians, Baptists, Friends and Mormons. Nat. Reg.

NB 10 Philadelphia Watch Case Company Building

Pavillion and Lafayette Avenues, Riverside (1852, 1907). A large three-story hotel constructed in 1852, and a seven story trapezordol office structure completed in 1907. The buildings are associated with what was once the world's largest watch case factory. Nat. Reg.

Camden County

NCa 01 Cooper House

7th Street in Pyne Point Park, Camden (eighteenth century). A one and a half story structure of sandstone constructed around 1700; adjoined to a 2-1/2 story brick structure built c. 1785. Known as Cooper's Ferry, the structures remained in Cooper family possession until 1825. Nat. Reg.; HABS.

NCa 02 Taylor House and Office

305 Cooper Street, Camden (1885). A 3-1/2 story stone and brick residence with arched entrance, elaborate bay and Flemish Renaissance gable, designed by Wilson Eyre, Jr. of Philadelphia for Dr. Henry Genet Taylor. Nat. Reg.; HABS.

NCa 03 Newton Friends Meeting House

722 Cooper Street, Camden (1824, 1885). A one-story frame structure on limestone footings built in 1824 and enlarged in 1885 to house the Friends Meeting founded in Camden in 1679. Nat. Reg.; HABS.

NCa 04 Whitman, Walt Historic District

Hinckle Street, 3rd and 4th Avenues, Camden (nineteenth century). This district contains 15 two-three story row houses, including a residence occupied by Walt Whitman from 1884 until 1892. Nat. Reg.; HABS; NHL.

NCa 05 Fairview Historic District

Hill and Olympia Roads, Mt. Eaphrim Avenue, Cresent Boulevard and North-South Freeway Camden (1917). Designed by Alexis Litchfield, the district contains 1000 residences, stores, offices, a library, church, and school, built during WWI to house workers at the Emergency Fleet Corporation shipyard. Nat. Reg.

Gloucester County

NG 01 Red Bank Battlefield

East bank of Delaware River and west end of Hessian Avenue National Park (1777). Fort Mercer, built by the Continentals in 1777, kept the British fleet from supplying the city of Philadelphia which they had occupied in September 1777. In October 1777 British and Hessians attacked the fort but were repulsed with heavy losses. The fort was abandoned in November 1777. One 2-12 story brick structure within the park dates from 1748. HABS; NHL.

NG 02 Whitall House

100 Grove Avenue, National Park (1766). A 2-1/2 story brick house with paired gable end chimneys built by James Whitall, Jr., a prominent Friend. Nat. Reg.; HABS.

NG 03 Fort Billings

Riverfront at Third Street Paulsboro (1777). Site of Revolutionary era fortification; exact location in some doubt. State Register.

NG 04 Vanleer Cabin

South side of US. 322, 2.5 miles west of Swedesboro (c. 1760). A squared log outbuilding with dovetailing, line motar chinking and wood shingles; twice moved. State Register.

NG 05 Stratton House

King's Highway, Swedesboro vicinity (1791-1794). A brick five-bay 2-1/2 story residence with gable dormers and paired gable end chimneys built c. 1794 by Dr. James Stratton. Born here, Charles Stratton, son of James, was first governor to be elected directly by the people of New Jersey. Nat. Reg.; HABS.

NG 06 Trinity Church

Church Street and Kings Highway, Swedesboro (1786, 1838). A red brick structure with two courses of round arched, multi-paned windows, designed and built by Swedish Lutheran minister Reverand Nicholas Collin in 1784; two years thereafter the church was deeded to the Episcopal Church. Nat. Reg.; HABS.

Salem County

NS 01 Finn's Point Rear Range Light

Fort Mott and Lighthouse Roads, Pennsville (1876). A wrought iron, riveted tower 100' high, formerly topped by light apparatus, erected in 1876-7 by the Kellogg Bridge Company of Buffalo N.Y. for the U.S. Lighthouse Establishment; in use until c. 1930 when the lenses were removed. Nat. Reg.; HAER.

NS 02 Fort Mott and Finns Point National Cemetery Historic District

Fort Mott, Pennsville (c. 1865). A 146 acre state park, the site of an early coastal defense built to protect the mouth of the Delaware River. The fort was used as a prison for Confederate soliders; more than 2000 died there and were interred at the Finns Point National Cemetery. Nat. Reg.

NS 03 Market Street Historic District

9-119 Market Street and East Broadway, Salem (eighteenth-nineteenth century). The district contains a preponderance of 2-1/2 and 3 story brick houses built in a variety of architectural styles. Market Street served as the headquarters of both colonial and post-Revolutionary governing bodies for the city and county. Nat. Reg.; HABS.

NS 04 Nicholson House

Amwellbury Road near Featherbed Land Elsinboro Township (1752). A 2-1/2 story, two level brick home with a recent one-story addition; the house was built in 1752 by Samuel Nicholson, son and grandson of two of the earliest settlers in Salem County. Nat. Reg.

NS 05 Homeland (Holme House)

Fort Elfsborg-Hancock's Bridge Road, Elsinboro Township (1784). A two and a half story brick, three-bay-by-two-bay residence; built in 1784 to replace a structure burned in a British raid. Benjamin Holmes, owner of the 1784 house had been a member of the Committee of Correspondence, legislator and member of the Salem County militia. Nat. Reg; HABS.

NS 06 Hancock House

Handcocke Bridge (1734). A two and a half story brick structure with gable dormers built around 1734. The house was the site of a British raid in 1778 in which several Patriots were killed. Nat. Reg.; HABS.

Cumberland County

NCu 01 Giles House

143 West Broad Street, Bridgeton (1791). A 2-1/2 story T-plan frame and clapboard structure with hip roof; built in 1791 for General James Giles who had served as a military officer during the American Revolution. Nat. Reg.; HABS.

NCu 02 Broad Street Presbyterian Church

Broad and Lawrence Streets, Bridgeton (1792). A brick structure with gable roof, 3 bays on the gable ends and five bays on the main long facades; built in 1792 on land deeded to the Presbyterians by Mark Miller. Nat. Reg; HABS.

NCu 03 Potter's Tavern

49-51 Broad Street, Bridgeton (eighteenth century) A two and a half story frame and clapboard structure on a stone foundation built c. 1775, a popular hotel because of its proximity to the Cumberland County Courthouse. Nat. Reg.

NCu 04 Seeley House

274 East Commerce Street, Bridgeton (c. 1799-1815). A two-story, three-bay brick structure with a gable end chimney; built in 1799 by S. W. Seeley and altered in 1815 by Robert McGee. Nat. Reg; HABS.

NCu 05 Buck House

297 East Commerce Street, Bridgeton (1808). A two and a half story Federal style structure of brick; built by Jeremiah Buck, the owner of a grist mill and sawmill; subsequently owned by the Elmer Family whose members were active in local politics for fifty years. Nat. Reg.

NCu 06 Maskell House

Bacon's Neck Road, Greenwich vicinity (1698, 1725). A colonial farm residence with a two-story gable roof; frame portion built c. 1698; two-story flemish bond brick addition built c. 1725. The Maskels held local executive office; one was county sheriff; they were active Patriots during the Revolution. Nat. Reg.; HABS.

NCu 07 Greenwich Historic District

Main Street, Greenwich (eighteenth to nineteenth century). Approximately 20 houses, stores, and places of worship constructed primarily during the eighteenth and nineteenth centuries; one of the last changed colonial towns on the eastern seaboard. Nat. Reg.; HABS.

NCu 08 Millville's First Bank

Second and East Main Streets, Millville (1857). A two-story Italianate structure built in 1857 to house Millville's first bank. Refurbished in 1883, the building served as the Millville Public Library from 1908 to 1963. State Register.

NCu 09 Old Stone Church

Fairton-Cedarville and Sayres Neck Roads, Fairfield Township (1780). A one story stone structure with two courses of rectangular 12 over 12 windows, gable roof; built in 1780 by the founding fathers of the Presbyterian Society. Nat. Reg.; HABS.

Cape May County

NCy 01 Dennisville Historic District

Dennisonville (nineteenth century) The district contains a number of additive homes, a township hall, and a church--all of frame construction. The structures range in date from the mid-eighteenth century to the 1890's, with the majority falling in the era between 1800 and 1850. State Register.

NCy 02 Cape May Lighthouse

Cape May Point (1859). The brick lighthouse is 175' high and can be seen for 19 miles. The third Cape May Point lighthouse, this structure was built in 1859. Nat. Reg.

NCv 03 Cape May Historic District

Cape May City (c 1850-1910). Cape May historic district contains one of America's largest assemblages of late nineteenth century frame buildings. It encompasses over 600 summer houses, Victorian hotels and commercial structures. NHL; HABS.

CONCLUSIONS

Archeological Sensitivity

Development of an archeological sensitivity model for the margins of Delaware Bay was a central task of this study. Basic research toward that end involved examination of state site files, perusal of relevant literature and consultation with professional and amateur archeologists -- all of which was directed toward ascertaining the location, nature and expected variability in prehistoric archeological sites in the region. Exact site locations, where known, were not recorded and will not be presented here, at the request of the state officials charged with maintaining site data confidentiality. Instead, a generalized graphic presentation is offered which takes into consideration the variability (and, by the same token, predictive strength) inherent in the archeological data base of each state.

A summary of current archeological knowledge for the Bay region has been presented in another report section. Central to modern archeological research is a recognition of the interrelatedness of cultural and natural systems, particularly in pre-agricultural periods. Recent investigations in coastal Delaware and New Jersey have involved reconstruction of paleoenvironments and emphasize the influence different micro-environmental factors had on the location, size, content and economic orientation of prehistoric sites. Most intensive research has centered on Woodland or

later period sites; the reasons for this and the lack of data on Archaic and Paleo-Indian sites have been discussed elsewhere. A general settlement system can be hypothesized, however, that should characterize most prehistoric periods. Aboriginal inhabitants of the coastal and riverine environments of Delaware, New Jersey and Pennsylvania engaged in seasonal exploitation of certain key resources, scheduling group movements to coincide with availability of those items and with other factors such as weather conditions. Optimal location of permanent and transient camps involved considerations of distance to resources, available storage technologies, carrying capacity of the exploited micro-environments and, possibly, external socio-political restaints on group movement within larger geographic territories. This basic Eastern Woodlands economic pattern of scheduled seasonality has been discussed in some detail by Caldwell (1958), Cleland (1976) and others.

A fairly detailed analysis of those factors which effected prehistoric settlement in the Bay area has been presented by Thomas et al. (1975). Additional comment and corroborative evidence also has been provided by Griffith (1976), J. Kraft (1977) and Kraft and John (1978). The basic settlement model is based on information gained through analysis of site placement in relation to key resources like white-tail deer, nuts, shellfish, anadromous

fish, waterfowl, potable water and less obvious factors like soil type. Recovery of floral and faunal remains from archeological contexts, comparative data from other sites in eastern North America, analyses of tool forms and ethnographic data are presented as evidence for utilization of those resources.

Five distinct settlement patterns are offered as explanatory models for differential site distributions in the Delaware coastal and estuarine zone. Each involves various combinations of base, transient and seasonal camps oriented in fairly linear patterns or within drainage, as opposed to across-drainage,bases. Sites are identified as to size, cultural/temporal components and season(s) of occupancy (based on recovery of season-specific floral and faunal remains). With minor variations, the postulated models involve larger base camps at mid or upper portions of tributary streams and smaller, seasonably-occupied extractive sites on headwaters and near coastal marshes.

Examination of detailed site location maps at the Island Field Museum indicates that recorded sites tend to cluster within drainages on a tri-partite basis of upper,middle and lower drainage. Similar patterns obtain from site data available at the New Jersey State Museum, although specific models as proposed by Thomas et. al. have been tested only on a

casual basis for the eastern shore of Delaware Bay. Mounier's (1974) excavations in the Maurice River drainage appear to confirm the existence of analogous site patternings for New Jersey. Data from Pennsylvania are lacking, but identical economic patterns are not expected to obtain for the geographical portions of our study area where resources like shellfish and resource areas like coastal marshes are absent. As previously discussed, many of the archeological sites once present in the Philadelphia environs have probably been destroyed or obscured by urban and industrial expansion.

A series of site density overlay maps has been produced by staff members of the New Jersey State Museum in connection with a study of the Passaic River basin (Williams et al. 1978). The maps are based on available, non-systematic survey data and indicate that the highest density of sites for our study area occurs in the vicinity of towns like Millville, Bridgeton, Salem, Camden and Trenton -- sites of historic population concentration here increased land clearing and subsequent collector activity have led to disproportionate site discovery rates. Lower site densities calculated for the remaining portions of New Jersey along the Bay are attributable to lack of knowledge rather than actual absence of archeological sites, a fact recognized by the researchers (Williams et al. 1978:71).

Site files and maps of the Island Field Museum, New Jersey State Museum and William Penn Memorial Museum indicate that approximately 420 prehistoric archeological sites have been recorded for the coastal areas and mid and lower reaches of tributary streams along Delaware Bay. Temporal constraints prevented a systematic breakdown of those sites by cultural-historical period, size, land form or soil type, but a general series of notes was made concerning relative site densities and distributions. Literature reviews and interviews with state officials indicate that the majority of temporally identifiable sites are assignable to the Woodland period. Archaic and older sites are underrepresented in the records, or at least have not been recognized. As many as 50 percent of the sites in any one drainage lack cultural/temporal identification, although additional research conceivably could reduce that figure bv a substantial margin.

Figures 1A, 1B and 1C of this report indicate our appraisal of relative site densities and potential archeological sensitivity for areas along Delaware Bay. Zones of high, medium and low sensitivity are depicted, based on our research in the various state offices and on a projection of systematically derived data from certain areas to the larger Bay region. The sensitivity zones are based on actual and <u>expected</u> site occurrences. Lack of systematic

archeological surveys in the Bay area and a resultant incomplete data base cannot be emphasized too strongly. Any areas selected as dredge spoil dumping sites will require intensive archeological survey to determine the possible location and nature of cultural resources at each site. Evaluation of project impacts on each identified cultural resource should follow, with recommendations for mitigation of adverse impacts. Site significance analysis should be predicated, minimally, on criteria established by the Advisory Council on Historic Preservation, as embodied in the National Register of Historic Places.

High, medium and low sensitivity zones all contain archeological sites. Areas of the greatest sensitivity are known to have concentrations of prehistoric sites and should be completely avoided. Future construction or dumping activities that involve these areas should be coordinated with monitoring by a professional archeologist, in addition to preliminary surveys and evaluations. Medium sensitivity zones contain relatively fewer sites, or are expected to contain fewer significant sites than the areas of high sensitivity. They include landforms and drainage patterns that did not lend themselves to prehistoric settlement, as currently understood, a situation that is magnified for the low sensitivity zones. Sites do exist in this third zone, but are of low archeological visibility and will only

infrequently be encountered. Marshes typify the low sensitivity area; sites located in and around marshes, according to current models, are expected to be seasonal extractive camps which lack complex stratigraphy or substantial material remains. Low archeological sensitivity can also be projected for many areas of modern urban and industrial expansion. Our research constraints and mapping scales permit only gross definition of such areas.

To summarize,our limited research allows certain subjective statements to be made concerning prehistoric site density and distributions in the Delaware Bay region. Based on data available through published and unpublished sources, the following statements can be offered:

1. Prehistoric archeological sites occur on certain landforms, including stream terraces and elevations within and bordering marshes.

2. Sites are situated along streams, especpecially near confluences. Freshwater and brackish streams served both as resource procurement loci and transportation routes.

3. In a manner similar to statements 2 and 3 above, sites are located in and near the extensive marshes typical of the Bay, primarily for reasons of resource availability.

4. Prehistoric sites tend to concentrate near modern population centers. Land clearing for construction and agriculture has exposed sites, increasing the likelihood of their discovery by amateur and professional archeologists. Modern settlements also tend to be situated in proximity to streams and critical resources which also were attractants for prehistoric peoples.

Historic Sites

A review of the Inventory of Protected Sites presented earlier indicates that as of December 1978 the Delaware River and Bay Dredging Disposal study area contains 162 historic sites and districts which have been officially determined to possess cultural significance. A total of 157 of these sites and districts have been listed in, or judged eligible for listing in, the National Register of Historic Places. Section 106 of the National Historic Preservation Act of 1966 requires federal review of any federally funded undertaking which might have an adverse effect upon any property listed in the National Register. The New Jersey Register Law of 1970 requires similar review of publicly funded projects which might encroach upon or destroy any property listed in the New Jersey Register. Therefore, it is strongly recommended that the Philadelphia District COE Regional Spoil Disposal Plan avoid negative impact upon the 162 historic sites and districts which have been inventoried and mapped in this report.

BASE MAP SOURCE: U.S.G.S. 1:250.000 TOPOGRAPHIC QUADRANGLES
POTTSTOWN
Pottstown
Souderton
Telford
Doylestown
New Britain
Hatfield
Lansdale
Harleysville
Warrington
Chalfont
Kulpsville
Skippack
Royersford
Collegeville
Phoenixville
Spring City
Perkiomen Valley
Trooper
Audubon
Ambler
Center Square
Port Washington
Dresher
Willow Grove
Valley Forge
VALLEY FORGE STATE PARK
Centerville
Malvern
Green Tree
Wayne
Downingtown
West Chester
Paulsboro
Woodbury
Westville
CHESTER
WILMINGTON
Swedesboro
MONTGOMERY
CHESTER
BUCKS
MONTGOMERY
PENNSYLVANIA TURNPIKE
SCALE 1:312500
STATUTE MILES
5
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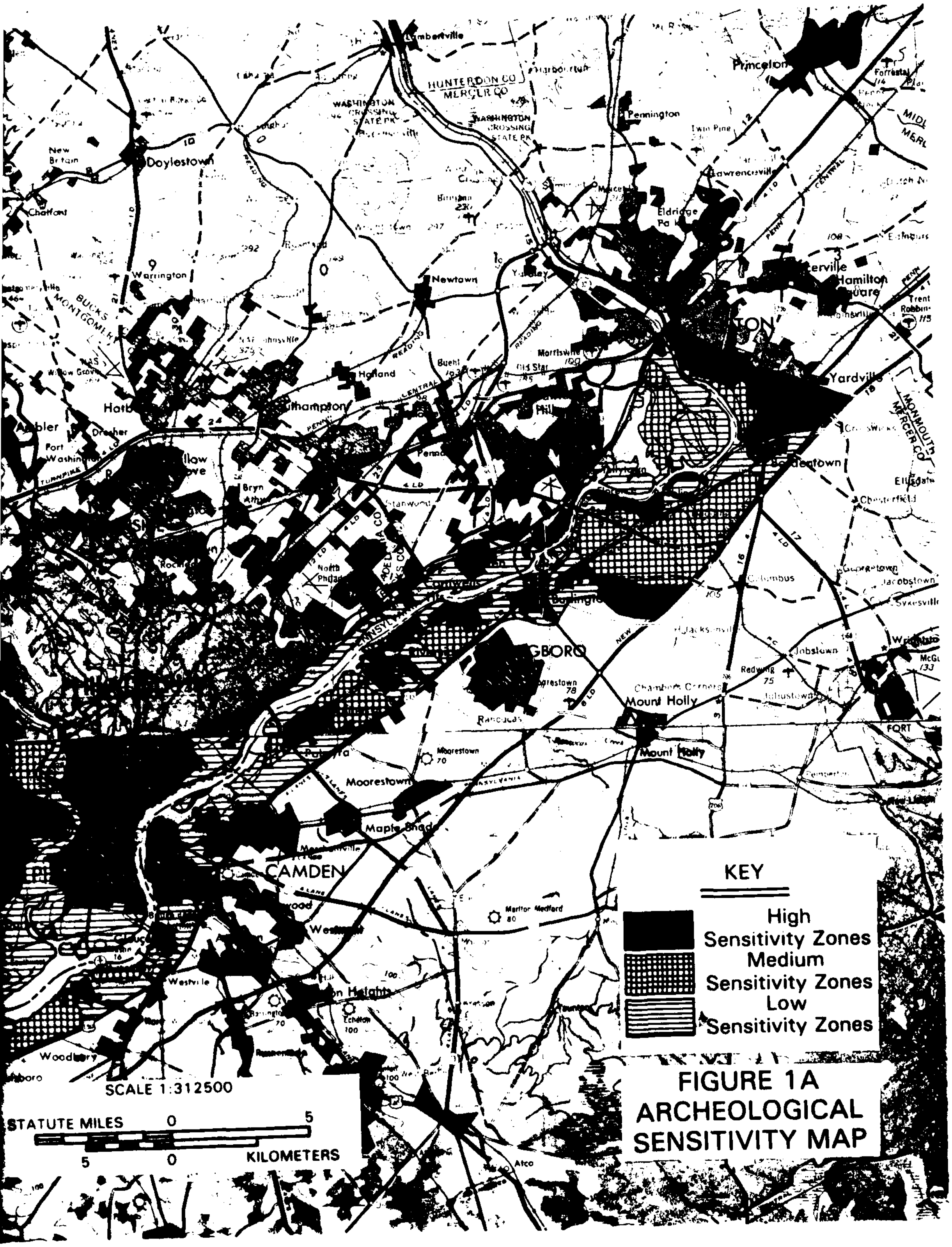
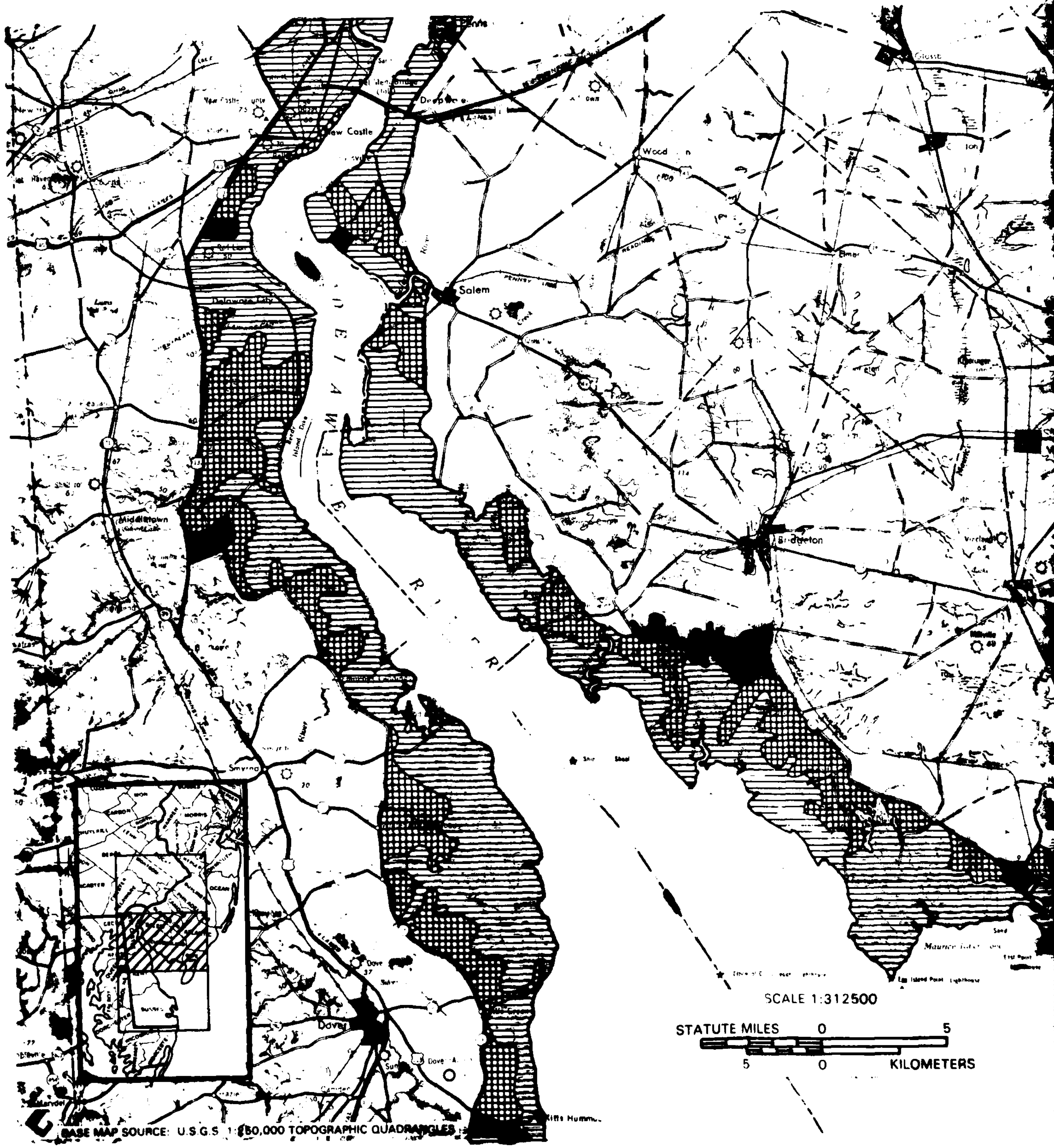


FIGURE 1A
ARCHEOLOGICAL
SENSITIVITY MAP


New Castle
Salem
Delaware City
Middletown
Bridgeton
Smyrna
Dover
Elmer
DELAWARE RIVER
SCALE 1:312500
STATUTE MILES 0 5
5 0 KILOMETERS
BASE MAP SOURCE: U.S.G.S. 1:250,000 TOPOGRAPHIC QUADRANGLES

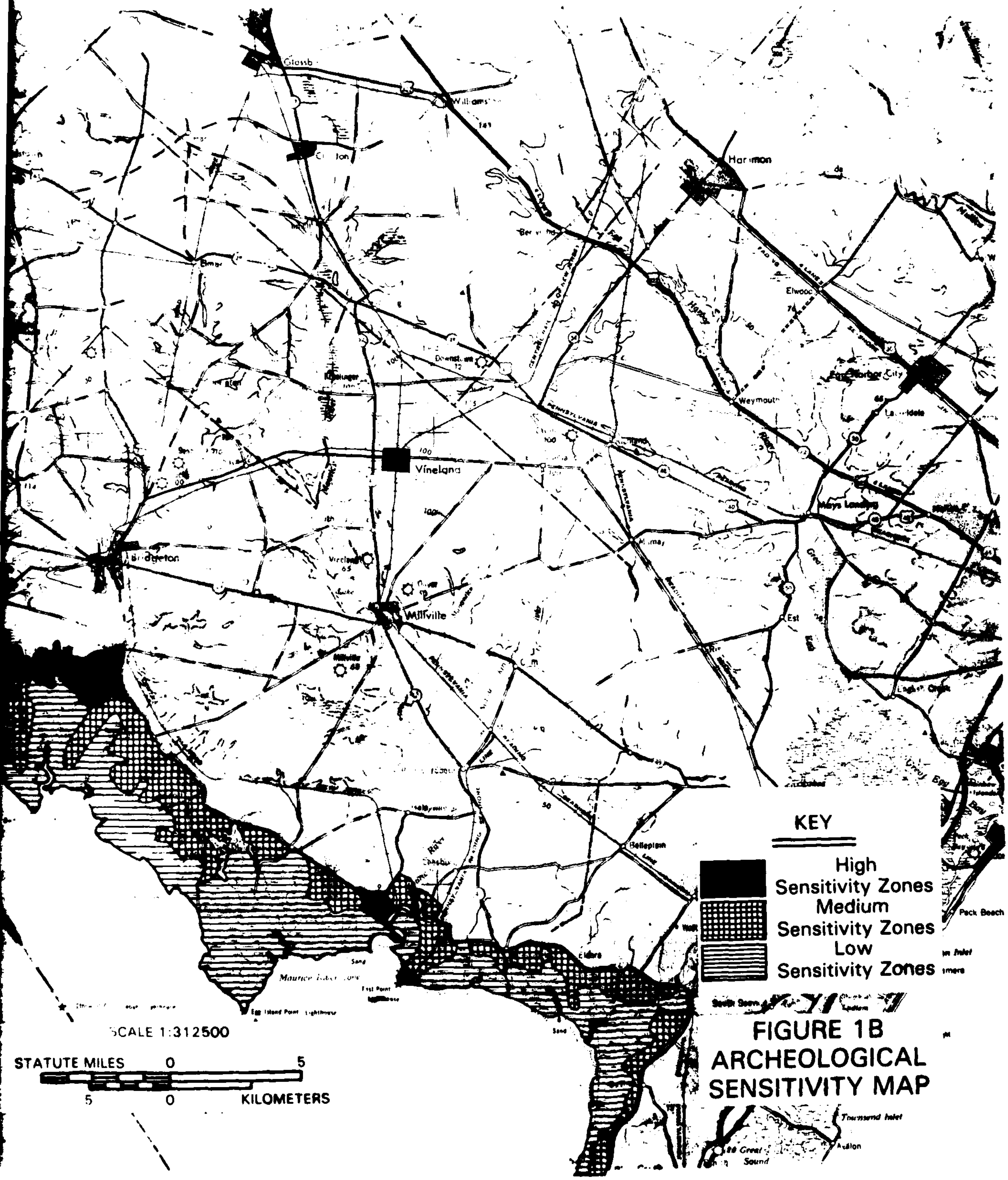
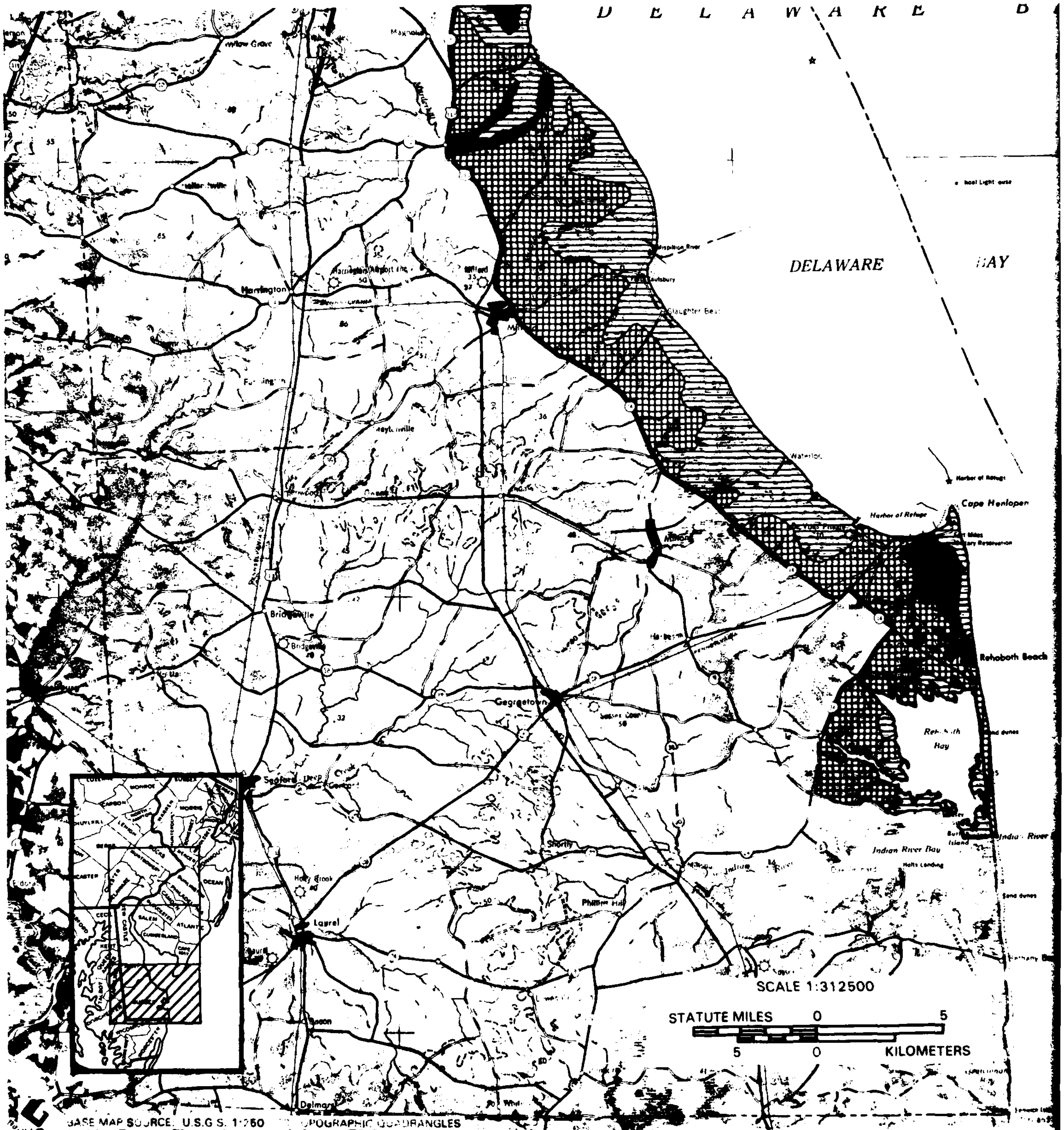


FIGURE 1B
ARCHEOLOGICAL SENSITIVITY MAP



D E L A W A R E B
DELAWARE BAY
Willow Grove
Magnolia
Harrington
Milford
Slaughter Beach
Waterloo
Harbor of Refuge
Cape Henlopen
Bridgeville
Georgetown
Rehoboth Beach
Rehoboth Bay
Seaford
Laurel
Indian River Bay
Delmar
SCALE 1:312500
STATUTE MILES 0 5
5 0 KILOMETERS
BASE MAP SOURCE: U.S.G.S. 1:250 TOPOGRAPHIC QUADRANGLES

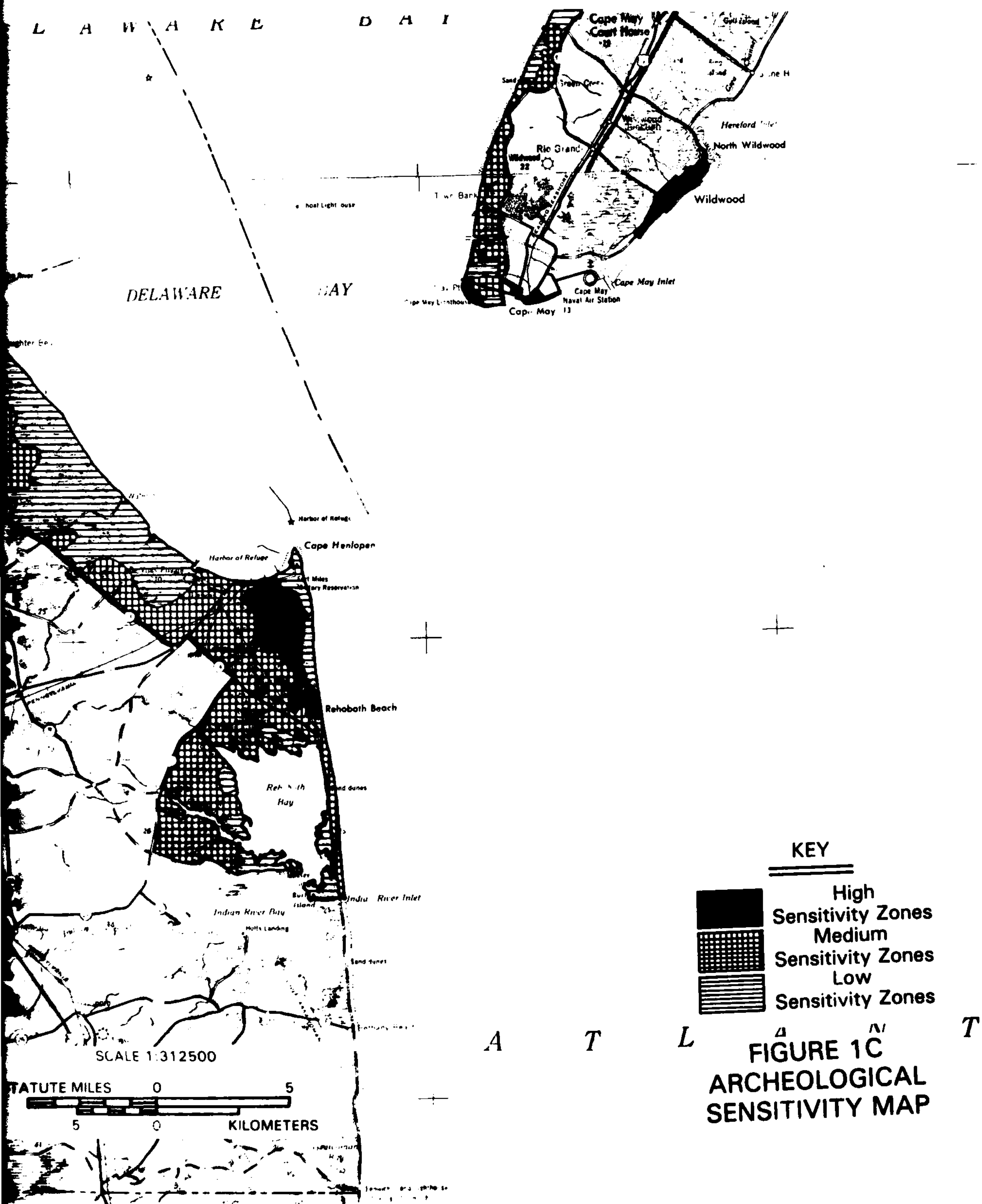


FIGURE 1C
ARCHEOLOGICAL
SENSITIVITY MAP

It should also be noted that these 162 inventoried historic sites do not comprise a complete listing of all properties of historic significance which might be adversely affected by the dredge spoil disposal plan. Comprehensive historic structure surveys have only been conducted in two of the thirteen counties in the project study area: Sussex County, Delaware and Burlington County, New Jersey. Even in these two counties, determinations of eligibility have not been made for all surveyed sites. Thus, it must be concluded that the study area contains numerous historically significant sites and structures which have not yet been surveyed and nominated to protected historic register status.

In the absence of comprehensive structure survey and designation, it is difficult to create a satisfactory project area model for zones of historic site potential. The inventoried historic property data can be discussed: included in the list of 162 designated sites are 22 historic districts which contain properties dating from different periods; 6 individual structures were built prior to 1700; and 73 individual structures were built between 1700 and 1800. Though this compilation of numbers and dates provides statistics on the progress of historic designation along the Delaware River and Bay, it reveals nothing about potentially significant properties which have not yet received historic designation. Likewise, the Figure 2 maps show the location of designated historic structures, but they do not locate eligible structures.

Two attempts have recently been made to develop predictive models for historic settlement patterns along portions of the Delaware Bay. Carol Wise, Historical Archeologist for the Delaware Bureau of Archeology and Historic Preservation, has recently presented two excellent papers which state that Delaware's early historic settlement pattern involved dispersed single family farmsteads located close to the edge of well drained soils. The earliest settlements were near the stream mouths on the Delaware, while later settlements were located farther inland. Wise notes that by around 1730 the location of farmsteads began to shift away from creek beds to roads which were located at drainage divides. She correlates this change in settlement from drainage edge to drainage divide and from river access to road traffic with a change in agricultural production from tobacco to wheat (Wise 1978; Wise October 1978).

The settlement model presented by Wise suggests that the well drained site of the transition zone between well and poorly drained soils should be carefully examined for evidence of early European settlement. She further suggests that later eighteenth century structures tend to be located along mid-drainage roads. These important generalizations, however, are based primarily upon extensive survey in Sussex County,Delaware, an area little characterized by colonial urbanization. Different geological drainage patterns and

different patterns of urban settlement may render her conclusions inapplicable to other regions of the Delaware River and Bay (Historic Resources of St. Jones Neck 1979).

Barbara Liggett has compiled a Historical Gazetter of New Jersey which dates the use of place names for all political subdivisions of New Jersey government: counties, townships, boroughs, and cities. Then,by cross-referencing current road map place names with the place names found in the Historical Gazetter, Liggett has prepared sensitivity maps of projected and known areas of historic importance for Cape May County and the Maurice River drainage in New Jersey. But such mapping only indicates that a political subdivision has preserved its historic name, not that it has preserved its historic structures. Thus, in the opinion of the Commonwealth project historian, such mapping is of little value unless it is substantiated by comprehensive on-site historic structure survey (Liggett 1977; Bartlett 1978).

Because the Delaware River and Bay have not been subjected to comprehensive historic structure survey and evaluation of significance and because no predictive models of historic site sensitivity have been developed which can apply to all portions of the River and Bay, the Commonwealth project team recommends that additional site-specific historic survey and evaluation be conducted prior to the final selection of each location chosen for spoil disposal.

PB 20
PB 22
PB 11
PB 10
PB 01
PB 28
PP 32
PP 63
PP 130
PP 40
PP 75
PP 77
PP 38
PP 06
PP 72
PP 109
PP 30
PP 31
PD 37
PD 27
PD 17
PD 19
PD 21
PD 11
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PD 22
PS 30
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DN 874
DN 340
DN 338
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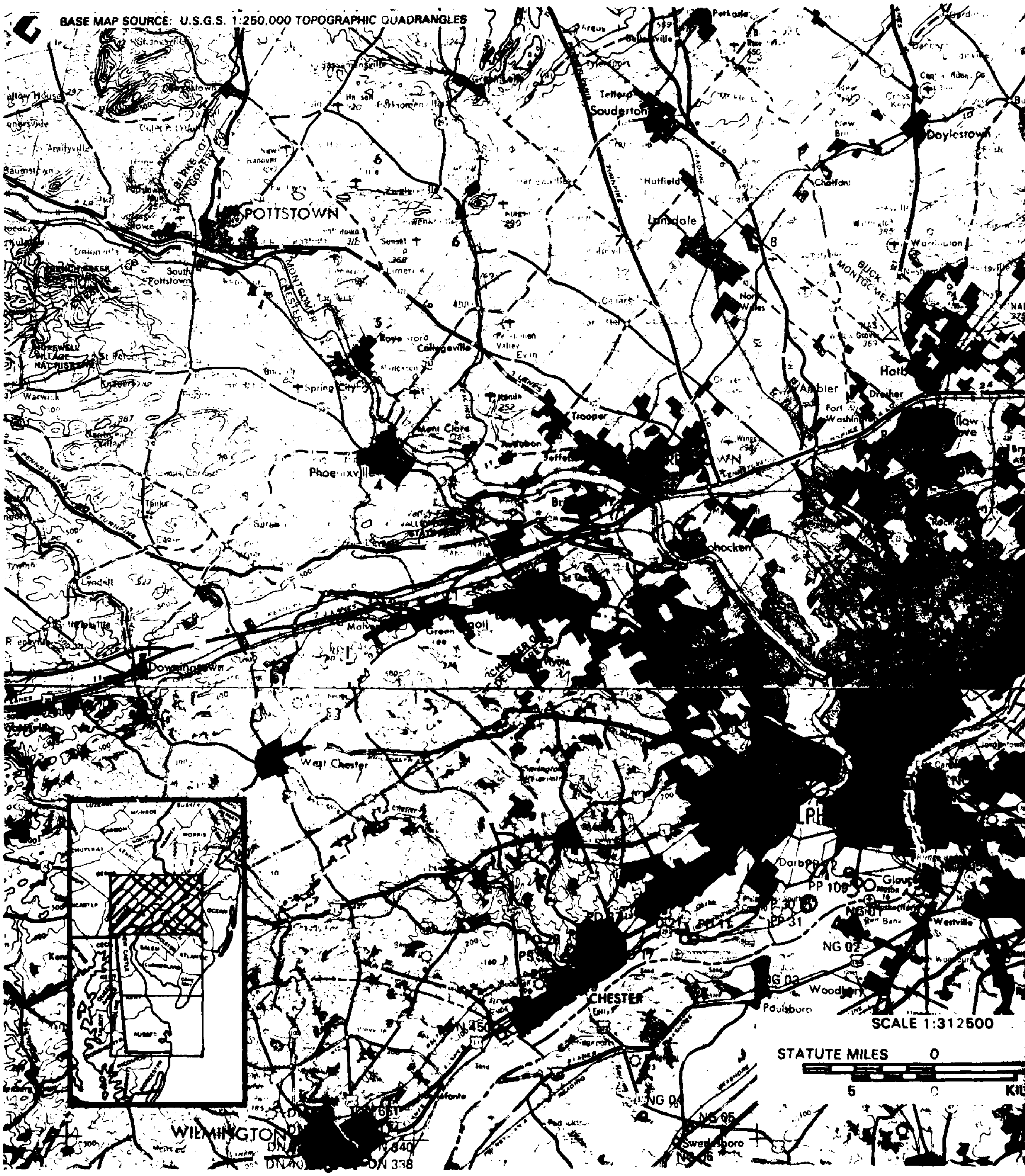
DN 651
DN 3637
DN 4018



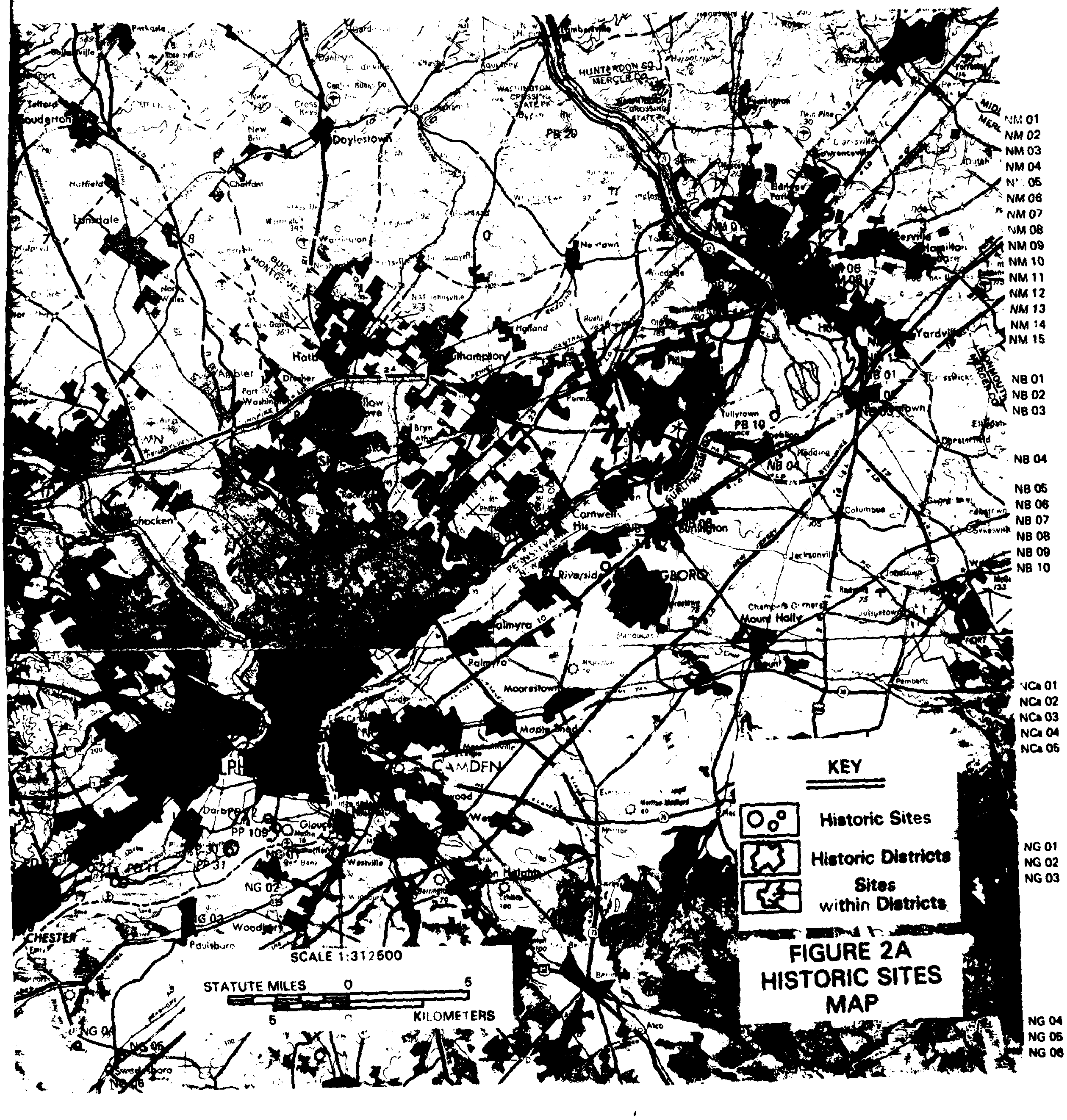
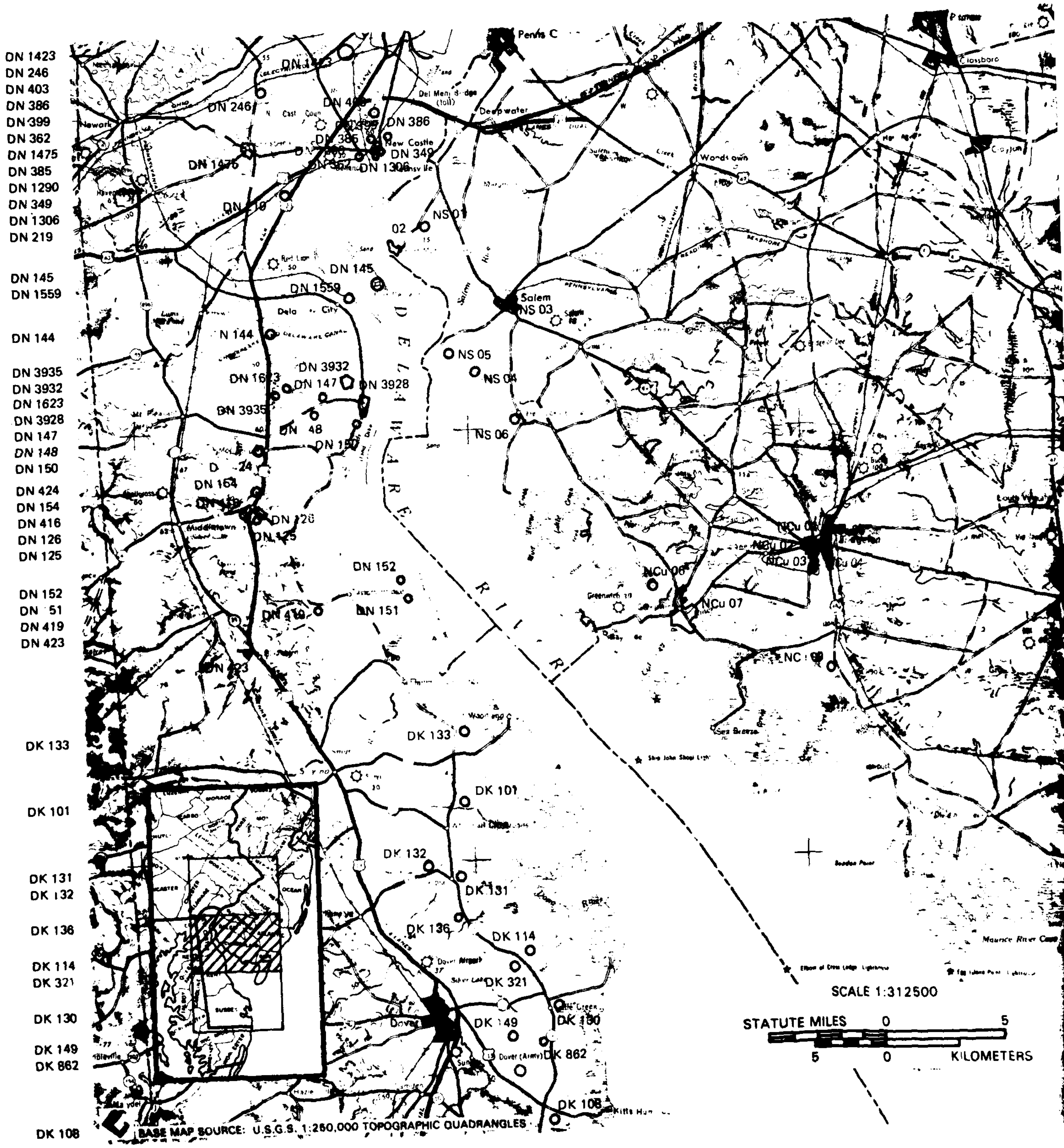


FIGURE 2A
HISTORIC SITES
MAP



DN 1423
DN 246
DN 403
DN 386
DN 399
DN 362
DN 1475
DN 385
DN 1290
DN 349
DN 1306
DN 219
DN 145
DN 1559
DN 144
DN 3935
DN 3932
DN 1623
DN 3928
DN 147
DN 148
DN 150
DN 424
DN 154
DN 416
DN 126
DN 125
DN 152
DN 51
DN 419
DN 423
DK 133
DK 101
DK 131
DK 132
DK 136
DK 114
DK 321
DK 130
DK 149
DK 862
DK 108
Newark
New Castle
Deepwater
Salem
NS 01
NS 03
NS 04
NS 05
NS 06
Middletown
NCu 06
NCu 07
NCu 03
Dover
Clossboro
SCALE 1:312500
STATUTE MILES
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5
5
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KILOMETERS
BASE MAP SOURCE: U.S.G.S. 1:250,000 TOPOGRAPHIC QUADRANGLES

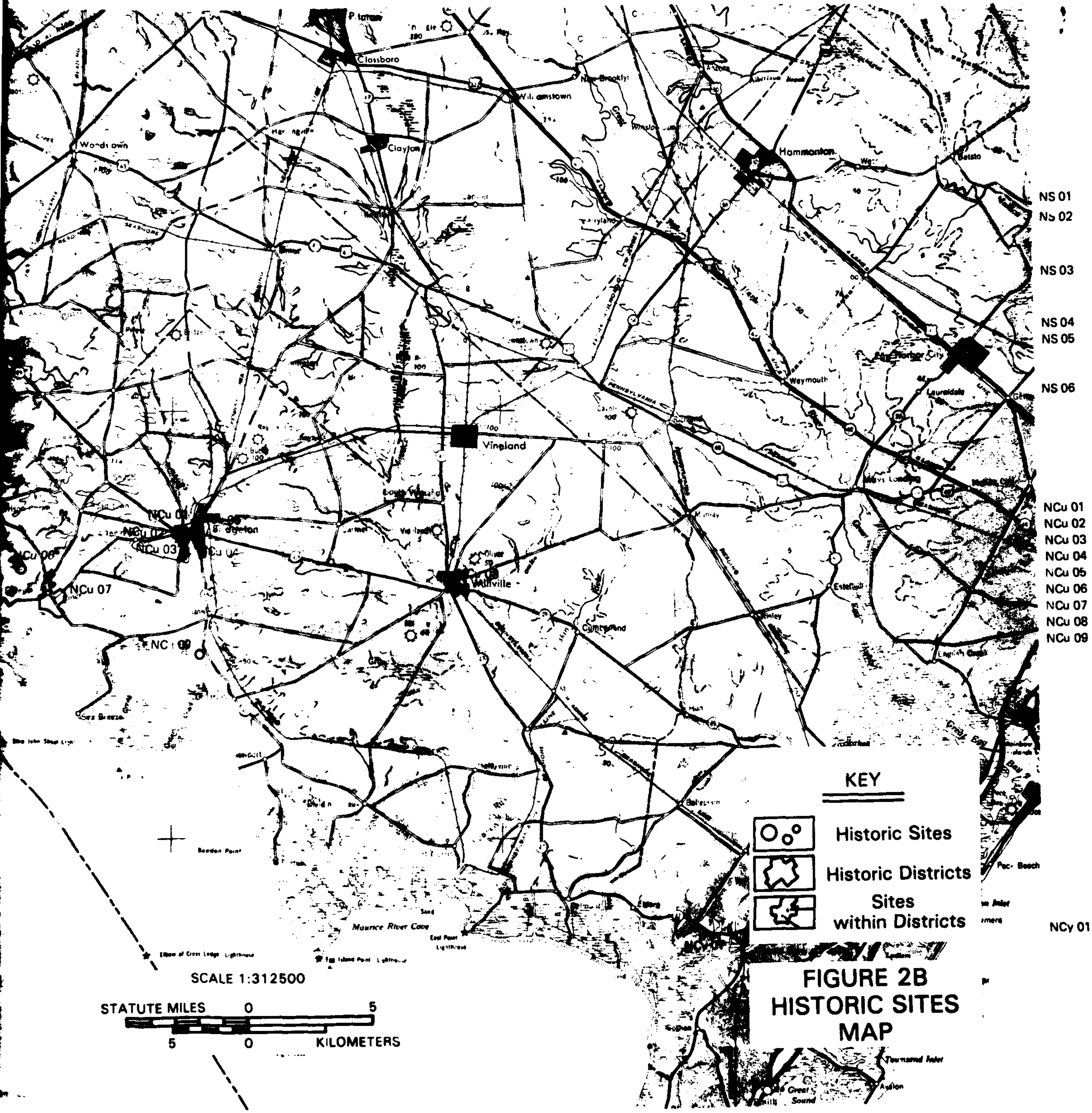

FIGURE 2B
HISTORIC SITES
MAP

DK 117
DK 113
DK 137
DK 121
DK 103
DK 123
DK 322
DK 129
DK 360
DK 244
DK 167
DK 116
DK 171
DS 177
DS 186
DS 160
DS 174
DS 175
DS 140
DS 314
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DS 139
DS 142
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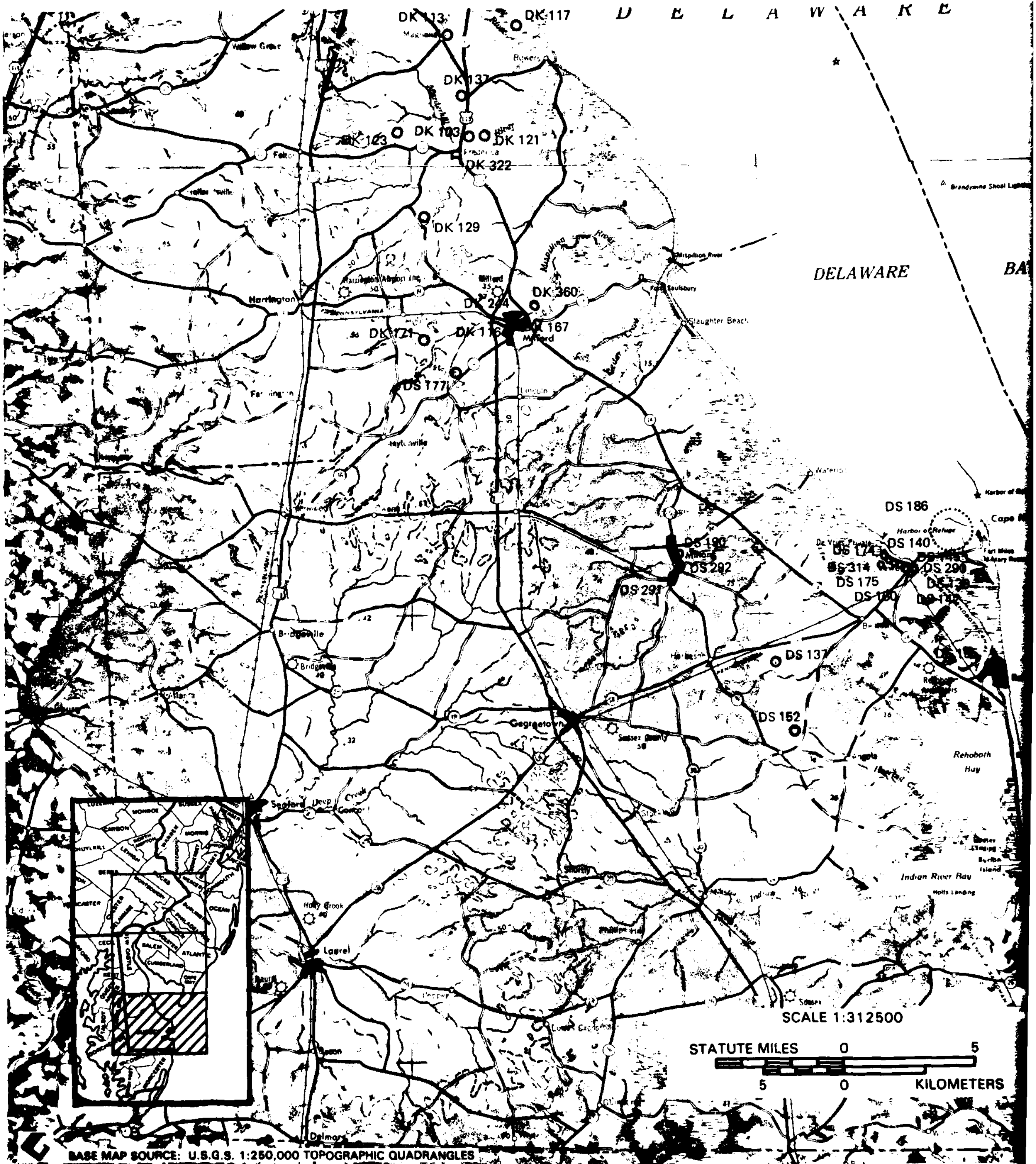
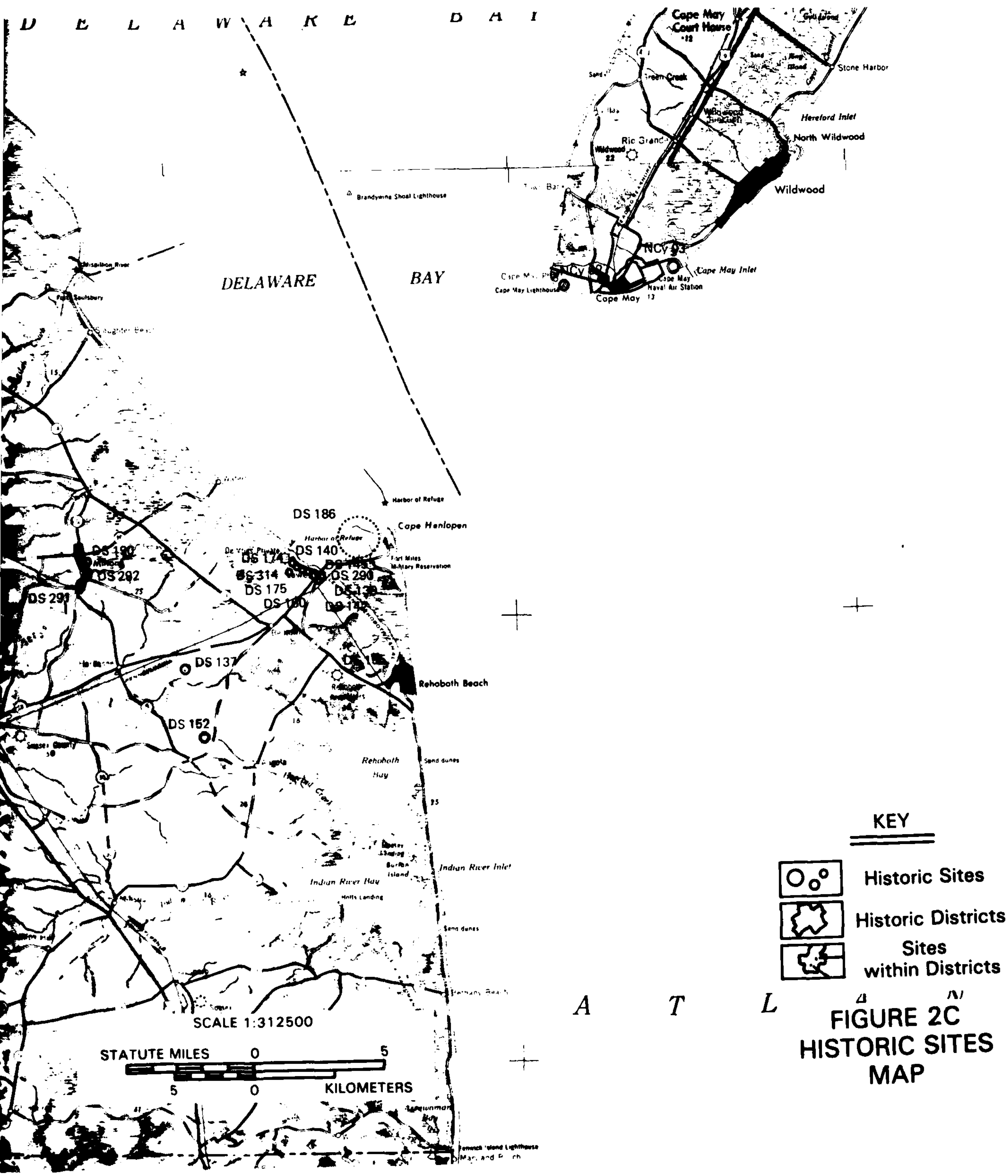
DS 145
DS 291
DS 292
DS 137
DS 155
DS 152





NCy 02
NCy 03

FIGURE 2C
HISTORIC SITES
MAP

APPENDIX

CITY OF PHILADELPHIA

PHILADELPHIA HISTORICAL COMMISSION
1313 City Hall Annex
Philadelphia, Pennsylvania 19107
MU 6-4543 and MU 6-4583

8 February 1979

John R. Kern, Ph.D
Historic Preservation Planner
Gilbert/Commonwealth
Commonwealth Associates Inc.
209 E. Washington Avenue
Jackson, MI 49201

RE: 62-0131-005

Dear Dr. Kern:

I have reviewed the list of historic sites in your letter of 29 December 1978 and should like to add three more. They are the Old City National Historic District and Fairmount Park and the Spring Garden National Historic District.

The first of these is bounded on the north by Wood Street, on the west variously by Fifth Street and Fourth Street, on the south by Independence National Historic Park and the Society Hill National Historic District, and on the east by Front Street.

Fairmount Park is on the National Register as a National Historic Landmark. It extends along both banks of the Schuylkill River from Spring Garden Street to the Wissahickon Creek and along both banks of that stream to Northwestern Avenue.

The Spring Garden National Historic District is bounded on the north variously by Fairmount Avenue and Green Street, on the east variously by Nineteenth Street and Fifteen Street, on the south by Spring Garden Street and on the west by Twenty-fourth Street.

In addition you may wish to consider any impacts on the Thirtieth Street Station and College Hall, both National Register properties, as well as the academic campus of the University of Pennsylvania which has been nominated to the Register.

John R. Kern, Ph.D
8 February 1979
Page Two

The significance for each of these additions may be determined by consulting the National Register nomination forms.

I hope that this proves of some assistance to you.

Yours truly,

Richard Tyler

Richard Tyler
Historian

RT:mk

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SECTION D-2

GILBERT/COMMONWEALTH

R- 1980

CULTURAL RESOURCES OVERVIEW IN THE PHILADELPHIA COE DISTRICT INDIAN RIVER AND BAY, DELAWARE

SUBMITTED TO

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT
CORPS OF ENGINEERS
CUSTOM HOUSE-2D AND CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

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INTRODUCTION

Gilbert/Commonwealth was contracted by the Department of the Army, Philadelphia District, Corps of Engineers to conduct various cultural resources investigations within the Philadelphia District. Task No. 3 under the contract was to provide a cultural resources overview of the Indian River and Bay area in southern Delaware. This investigation was designed to provide the following services:

1. An historical and archeological literature and background search, including the National Register of Historic Places and site files of the State Historic Preservation Office.

2. Determination of probable sensitive areas to the possible location of prehistoric and historic resources.

Archival and literature search for this project was conducted at the Delaware Department of State, Division of Historical and Cultural Affairs, Bureau of Archeology and Historical Preservation; the Island Field Museum; and the Sussex County Planning and Zoning Department on October 31, and November 1 and 2, 1978 by Jeffrey C. Kimball and John G. Albers. Indian River and Bay reconnaissance was undertaken November 1 and 2 by Albers and Kimball.

This reconnaissance was restricted to an extensive "drive through" of the area. The field team undertook a reconnaissance evaluation of the architectural resources of the area and acquainted itself with the environmental conditions present. No actual on-the-ground archeological survey was undertaken during the reconnaissance.

The archive and literature search resulted in the location of 31 prehistoric sites and four historic sites within the Indian River and Bay area. (See Table 1 for a complete listing of these sites and Figure 1 for the locations of these sites.) Of these sites, the following are listed on the National Register of Historic Places.

PREHISTORIC SITES

1. S-638, 75-F-13, Townsend Island Site
2. S-639, 75-F-11, Possum Point Site
3. S-640, 75-F-12, Swan Creek No. 2 Site
4. S-649, 75-G-22, Poplar Thicket Site

Sites No. S-638, 639 and 640 comprise the Indian River Middle Woodland Archeological Complex.

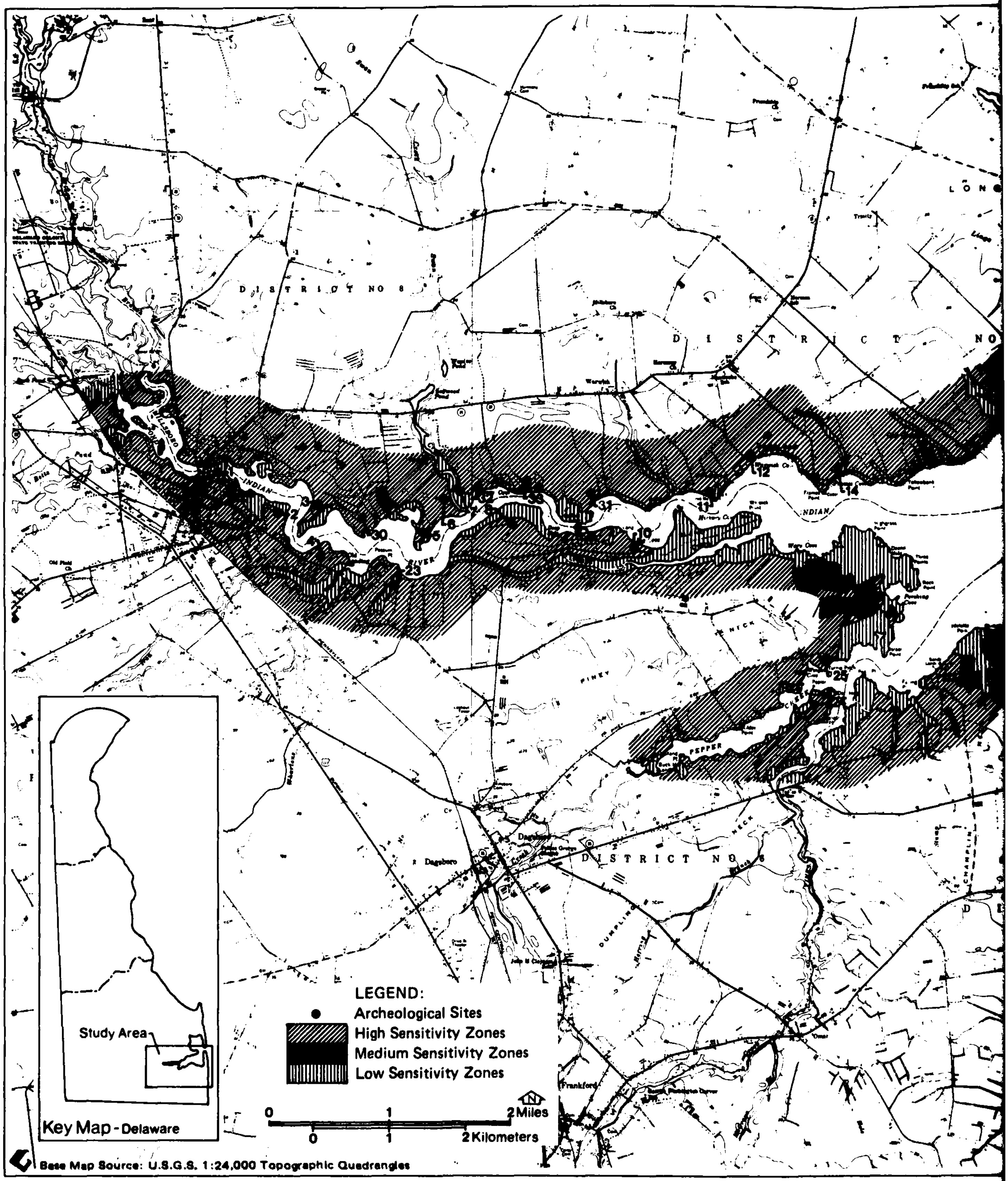
HISTORIC SITES

1. Isaac Harmon Farm
2. White House Farm
3. Prince George Chapel
4. Indian River Life Saving Service Station

TABLE 1

ARCHEOLOGICAL AND HISTORIC RESOURCES
*NATIONAL REGISTER

Map	CRS	State Site	Description
1	S-634	75-F-6	Millsboro Site 1
2	S-635	75-F-7	Millsboro Site 2
3	S-636	75-F-1	Indian River Site 1
4	S-637	75-F-8	Millsboro Site 3
*5	S-638	75-F-13	Townsend Island Site
*6	S-639	75-F-11	Possum Point Site
*7	S-640	75-F-12	Swan Creek Site 2
8	S-641	75-G-10	A Middle Woodland Site
9	S-642	75-G-41	Delmarva Power and Light Burton's Island Site 1
10	S-643	75-G-42	Delmarva Power and Light Burton's Island Site 2
11	S-644	75-G-19	Downs Landing Site
12	S-645	75-G-39	Warwick Cove
*13	S-751	-	Isaac Harmon Farm
14	S-761	75-G-71	-
*15	S-648	-	White House Farm
*16	S-649	75-G-22	Poplar Thicket Site
17	S-650	75-G-1	Long Neck (Massey's Landing) Site
18	S-727	75-G-58	-
19	S-646	75-G-8	-
20	S-647	75-G-21	Walter's Point Site
*21	S-453	-	Indian River Life Saving Service Station
22	S-651	75-G-11	Quillen's Point Site
23	S-676	75-J-7	Humes Site
24	S-678	75-K-3	Pooles Point
25	S-679	75-K-1	Revel Site
26	S-684	75-K-15	-
27	S-683	75-K-6	-
28	S-682	75-K-5	Harmon Site
29	S-687	75-K-13	-
30	-	75-F-17	Middle and Late Woodland
31	-	75-G-62	Middle Woodland
32	-	75-G-63	Middle Woodland
33	-	75-G-75	Early Middle Woodland
34	-	75-K-21	Middle and Late Woodland
*35	-	-	Prince George Chapel



DISTRICT NO 8
DISTRICT NO
DISTRICT NO 8
INDIAN
RIVER
PEPPER
LEGEND:
Archeological Sites
High Sensitivity Zones
Medium Sensitivity Zones
Low Sensitivity Zones
0 1 2 Miles
0 1 2 Kilometers
Study Area
Key Map - Delaware
Base Map Source: U.S.G.S. 1:24,000 Topographic Quadrangles

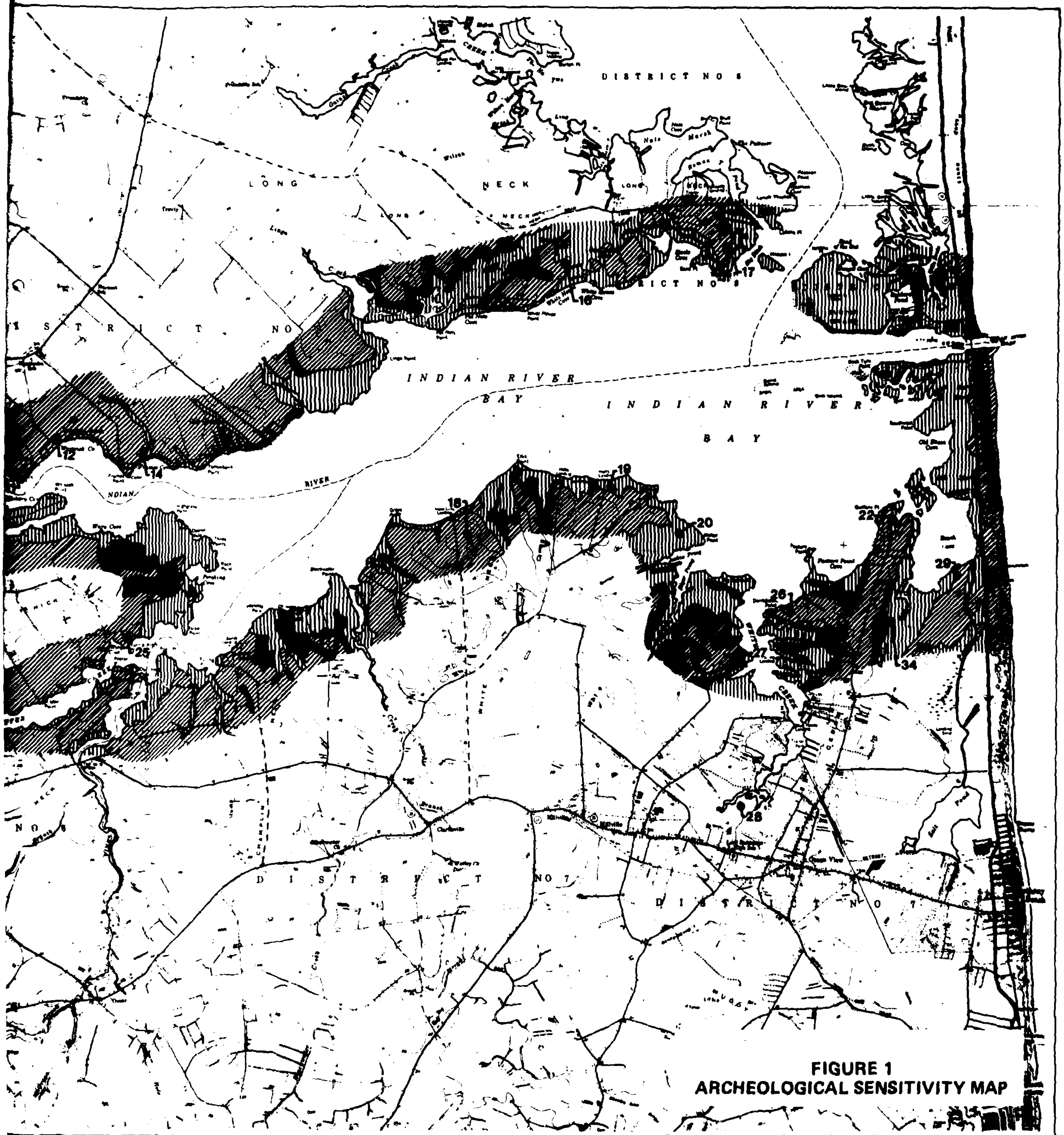


FIGURE 1
ARCHEOLOGICAL SENSITIVITY MAP

ENVIRONMENTAL SETTING

The Indian River and Bay area is located in the eastern part of the Delmarva Peninsula of the Atlantic Coastal Plain. The area is formed of mesozoic and cenozoic sediments that have been deposited in a linear trough or geosycline, parallel to the eastern margin of the North American Continent (Kraft 1977). For the last 1.5 million years, sea levels have risen and fallen over ten times across this coastal plain area. As a result, this coastal plain has been covered by Pleistocene Epoch and Holocene Epoch sediments that have been continuously reworked by the constant rising and falling of the sea level. Since approximately 14,000 years ago, sea levels have been rising as a consequence of the melting of the world's ice caps. The present geography of the Delaware Coastal Plain is a direct result of the changing geologic history of the Atlantic Continental margin through recent geologic time (Kraft and John 1978).

In addition to the various geological changes that have affected the area of Indian River and Bay, numerous environmental changes have taken place over the past 15,000 years. Approximately 10-15,000 years ago, the area was dominated by forests consisting of spruce, pine, fir and birch (Whitehead 1965 and Thomas et al. 1975). During this period, sea levels were approximately 100m lower than at present. The Atlantic coastal zone lay along the outer

edge of the continental shelf at this time (Kraft 1977). With the waning of the Wisconsin glaciation, the climax forests shifted to an association that included pine, spruce, birch and alder. By, 10,000 BP oak and hickory became the dominant association. Between 10,000 BP and 8,000 BP, the rate of sea level rises remained greater than several feet per century, causing rapid flooding of coastal areas (Kraft 1971, 1977). After 7,000 BP, the oak-hickory forest association was gradually replaced by black gum and cypress. By about 3,700 BP, the rising sea level had leveled off to about a foot per century, and has decreased since then (Thomas et al. 1975). Today, the Indian River Bay area is dominated with an oak-pine association.

ARCHEOLOGICAL BACKGROUND

The prehistoric resources of the Indian River and Bay can best be understood against the background of what is known about the rest of the Delmarva Peninsula and the entire eastern portion of North America. It has long been the custom of archeologists to divide the 12,000 or more years of human occupation in eastern North America into four basic cultural-chronological periods. These include Paleo-Indian, Archaic, Woodland and Historic periods. It is usual to define the Paleo-Indian period as the time between man's first settlement of the area until approximately 8,000 B.C., the Archaic period as lasting from 8,000 B.C. to approximately 1,000 B.C. and the Woodland period as lasting from 1,000 B.C. until either the time of the first historic settlement for the area or the first appearance of trade items of European manufacture. Within this cultural-chronological scheme, the Paleo-Indian period is often divided into early and late units; the Archaic into early, middle, late and, sometimes "Transitional" units; and the Woodland into its early, middle and late stages.

THE PALEO-INDIAN PERIOD

The term Paleo-Indian traditionally refers to the initial phase of occupation which took place in the region. Currently, there is a great deal of disagreement as to when this earliest occupation took place. There is a growing body of evidence that may indicate that man was in the new world as early as 30,000 B.C., and perhaps as early as 40,000 B.C. Krieger (1964), and others, have argued for the existence of a "Preprojectile Point" stage for North America where occupation is represented by crude chipped stone artifacts.

One such find comes from the State of Delaware north of the Indian River area. Human bone and a fragment of shell, with what has been interpreted as a mammoth or American mastodon incised on it, were found in salt marsh peats along the fringe of the tidal Delaware River near Holly Oak, Delaware River north of Wilmington (Thomas 1974 and Kraft and John 1978). Recent studies by Kraft and Thomas (1976) analyzed the potential for the Holly Oak discovery to be authentic. A series of borings was made across the narrow coastal plain of the tidal Delaware River. The results of this study did little to resolve the Holly Oak controversy. Until further work is done in this area, this find, like so many others, cannot be taken as an adequate documentation of an early preprojectile point occupation.

Approximately 11,000 years ago, there appears to have been a very widespread and uniform early Paleo-occupation throughout North America. This occupation is marked by the appearance of fluted points: lanceolate concave based spear or dart points with a flute or thinning flake removed from one or both faces of the point. The close similarity of radiocarbon dates on this horizon across North America (Haynes 1964) suggests that this occupation was a result of a very rapid migration of hunting people into eastern North America. This fluted point horizon has long been known and is well represented in the Delaware area (Mason 1959, Williams and Stoltman 1965, Thomas 1974).

Thomas (1974) has suggested that the distribution of fluted points finds and possible sites in Delaware relates to the location of suitable raw materials for chipping artifacts and to the most favorable locations for hunting inland game around freshwater sources.

In many parts of the eastern United States, it is possible to recognize what Mason (1962) has referred to as Late Paleo-Indian complexes: prehistoric cultures marked by straight based stemmed lanceolate points similar to the Scottsbluff types of the plains region and "unfluted points" similar to the Midland and Hi-Lo point types. Late Paleo-Indian artifacts do not seem to have been reported in the Delmarva Peninsula and there seems to have been a very

rapid transition from early Paleo-Indian styles to those of the Archaic period similar to those reported in the Carolina Piedmont (Coe 1964) and from along the Kanawha in West Virginia (Broyles 1971).

THE ARCHAIC PERIOD

The Archaic Period in eastern North America is marked by notched, stemmed and bifurcate stemmed projectile points, the appearance of ground stone tools and, in its latter or "transitional" stage, vessels carved from steatite. Throughout the region, the Archaic has been interpreted as more likely to have been based on a localized mixed economy including both hunting and gathering than that of Paleo-Indian peoples, which appears to have been more specifically oriented to hunting large late Pleistocene and early Holocene mammals.

While there are many surface finds of Archaic artifacts in the Delmarva Peninsula, few have been found in excavations and where they have been found, it has often been in generalized context where later materials are also present.

Toward the end of the Archaic, during the "Transitional" phase, there is an intensification of occupation marked by larger sites with more diversified

chipped and ground stone tool inventories. The Transitional Archaic is marked by the "broad spear" projectile point types and carved steatite vessels (Wise 1971).

THE WOODLAND PERIOD

The Woodland cultures in eastern North America are marked by the appearance of pottery vessels. An arbitrary date of 1,000 B.C. has been used for the beginning of the Woodland Period, although there is a great deal of variation in the first appearance of ceramics which seem to have diffused from south to north. The earliest fiber tempered pottery in the southeastern United States has been dated prior to 2,000 B.C. Ceramics from the Rais shelter in Ohio and the Webber site in Illinois appear to be older than 1,000 B.C., but the majority of early ceramic dates in the northeast and Canada seem to be between 600 B.C. and 1000 B.C.

An Early Woodland complex was discovered in Delaware in 1973 at the Clyde Farm site near Stanton (Thomas 1974). It was marked by ovate knives of a non-local quartzite and a flat bottomed ceramic vessel, similar in shape to the Late Archaic steatite vessels, which were tempered with crushed steatite.

Another Early Woodland complex in the Delmarva Peninsula is a very rich eastern representative of the Adena burial complex which was first identified in the Ohio Valley (Ritchie and Dragoo 1960, Thomas 1971). Delmarva Adena burials contain red ochre, tubular pipes, gorgets, copper and shell beads, and caches of exotic trade artifacts. Very little is known about the village sites of these people since most excavation has been carried out in mortuary areas.

Middle Woodland in the eastern United States is generally marked by the Hopewellian mortuary and village complex which is better represented in areas to the west of the Allegheny Mountains than it is in the mid-Atlantic region. Griffin (1967) has considered all complexes that are known to be contemporary with Hopewell as being a part of the Middle Woodland horizon. In the Delmarva Peninsula, the poorly known Carey and Oxford complexes (Thomas 1974) represent the main part of this time period.

The latter part of the Middle Woodland period is represented by the Webb Phase (ca. 700 A.D.) which is best known from the Island Field site near South Bowers (Thomas and Warren 1970). This site, situated on a low lying rise surrounded by tidal salt marsh, contains a major Amerinds cemetery (Kraft 1978).

The ceramic pipes, stone platform pipes, ground and polished stone tools and ornaments, the chipped stone tools and a small amount of pottery all indicate that it is Middle Woodland.

The Late Woodland occupation in Delaware is known primarily from larger coastal occupations and there are several clearly defined manifestations. These include the Milford Neck Complex, known primarily from the Millman Site (Thomas and Lewis 1966), which is marked by fabric impressed quartz tempered pottery; and the Townsend Complex, known from the Townsend (Omwake and Stewart, editors, 1963) and the Mispillion (Omwake 1962) sites, marked by shell tempered pottery. Thomas (1974) has grouped Townsend, Mispillion, and other sites into the Slaughter Creek Phase which he estimates to begin around 1200 A.D. and last until the period of European contact. He has suggested that the Slaughter Creek Phase may relate to the historic Nanticoke, Choptank, Assateague and Pocomoke Indians.

Europeans are known to have been in the Delaware area by 1632 and there should be early historic contact sites of aboriginal peoples dating to this time period. However, to date, none seem to have been discovered and reported in the archeological literature.

PREHISTORIC ADAPTATION IN THE DELMARVA PENINSULA

The existing land use patterns of the Indian River and Bay, and the entire Delmarva Peninsula, have changed radically during the past several centuries of intensive Euroamerican occupation. The prehistoric occupations likely to be found in the Indian River and Bay area should be interpreted in light of what the environmental variables and environmental potential were under aboriginal conditions. An excellent study of this resource base has been prepared by Thomas and his associates (Thomas et al. 1975). Their work needs to be summarized here since it has a direct bearing on the nature and extent of the prehistoric occupations which are likely to be encountered in the Indian River and Bay area.

This study is generalized in the sense that it is based on the immediate precontact conditions as developed from the contemporary environmental variables. It does not take into account the microenvironmental variations caused by sea level and climatic changes of the past 12,000 years. A recent study by Kraft and John (1978) has attempted to assess in detail various coastal settings in Delaware.

MICROENVIRONMENTAL POTENTIAL

Thomas and his colleagues recognize three major environmental types within the Delmarva Peninsula. These are a) poorly-drained to swampy woodlands, b) well-drained woodlands, and c) tidal marshes, coast and open salt-water areas.

The wet woodland areas are the optimal areas for exploitation of cottontails, deer, beaver, green plant foods, wild fruits, and edible roots. The dry woodlands are the optimal areas for the exploitation of grey-squirrel, wild turkey and mast. The tidal marshes are the optimal areas for muskrats, waterfowl, shellfish and seed food plants. In addition to these resources, anadromous fish are seasonally available in the major river systems. For the late prehistoric period, corn-bean-squash agriculture was also important.

In the same way that these resources are not equally distributed over the landscape, they are not equally available throughout the year. Some resources may be exploited only on a seasonal basis. Because of this variability in availability, Thomas and his associates have generated an optional scheduling model for resource exploitation in the Delmarva Peninsula that involves movement between habitats to maximize the return on all resources.

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DELAWARE RIVER DREDGING DISPOSAL STUDY, STAGE 1 RECONNAISSANCE --ETC(U)
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In a generalized sense, this can be characterized in the following manner. During the late summer, crops, seeds and shellfish, all available in or near coastal areas, would provide the major resource base. In early fall, deer, and edible roots would provide the greatest extractive return. Deer and edible roots could be harvested through mid-winter when waterfowl and shellfish would provide the subsistence base during the weakest link in the seasonal food chain. By mid-March, anadromous fish would be readily available and would continue to be available until mid-June. This basic model would provide for a maximum exploitation of the interior poorly drained woodlands in the winter months, a maximum exploitation of the coastal areas in the summer and utilization of intervening areas, dry woodlands and transitional areas, intensively in the spring and fall and less intensively during other seasons.

REGIONAL SETTLEMENT MODELS

Thomas and his colleagues have developed five theoretical models for human settlement which could be used to make efficient use of the areal and seasonal variation in resources. These involve base camps, seasonal camps and special purpose extractive sites. Model One postulates a series of seasonal camps located in poorly drained woodlands in the winter, along tidal marshes in

the summer and in the well drained woodlands in the spring and fall. Model Two involves the establishment of a base camp in the ecotone between the well drained and poorly drained woodlands with an emphasis on winter activities and seasonal camps located within the tidal marsh/well drained woodland ecotone for spring activities and within the tidal marsh area for summer activities.

Model Three involves two sets of base camps, one located in the wet woodland/dry woodland ecotone for winter activities and a second located in the tidal marsh area but utilizing the resources of the dry woodlands when they are most available. Model Four is less complicated and involves a single base camp, located in an area of well drained woodlands along a major river, with a summer season camp established in the coastal region and seasonal (winter) forays into the interior. Model Five is a further simplification with a single base camp similar to that postulated in Model Four and seasonal forays into both the wet woodland and tidal marsh areas.

These models were tested at two archeological sites in Delaware. The Hughes-Willes site, located in an area surrounded by 53 percent dry woodland, 32 percent poorly drained woodland, 12 percent transitional areas and only two percent tidal marsh, was interpreted as a

semipermanent fall to winter settlement within the Model Two or Model Three pattern. This was contrasted with the Indian Landing Site (75-G-1) located near Massey's Landing on the south shore of Long Neck which separates Rehoboth Bay from Indian River Bay (Figure 1). The surrounding area was 67 percent salt water bay, 23 percent tidal marsh, eight percent dry woodland, one percent wet woodland and one percent classified as transitional. The material recovered from Indian Landing indicated that it was a summer to early fall occupation seasonal camp in a tidal marsh area, which would be expected with either the Model Two or Model Four settlement patterns.

It is clear that the above study provides an important framework for the interpretation of Delmarva prehistory. It is of particular importance to the understanding of the cultural resources of the Indian River and Bay area.

PREHISTORIC LAND USE POTENTIAL IN THE INDIAN BAY AND RIVER

According to the generalized environmental map represented by Thomas and his colleagues (1975: Figure 3), the Indian River and Bay would appear to be primarily tidal marsh, coast and open salt water with minor areas of well-drained woodlands. A good example of the type of microenvironmental conditions existing in the Indian

River and Bay area can be found at the Indian Landing Site (75-G-1). This site is located near Massey's Landing on the south shore of Long Neck (Figure 1). Kraft (1975) has reported that a survey of the ten square mile area encircling the Indian Landing Site indicates the following microenvironments in order of decreasing size:

1. Salt Water Bay - 67 percent
2. Tidal Marsh - 23 percent
3. Well-drained Woodlands - 8 percent
4. Poorly-drained Woodlands- 1 percent
5. Transitional Area - 1 percent

While these percentages cannot be generalized over the entire Indian River and Bay area, they are useful in viewing the general characteristics of the surrounding environment. According to Kraft (1978), this general mix of microenvironmental setting would indicate that prehistoric settlement in the area would most likely be in the summer and early fall with primary activities being the gathering of shellfish and reeds, as well as some fishing.

Of importance for site location in the area is the distribution of: 1) well-drained woodland, 2) poorly-drained woodland, and 3) transitional zones.

The well-drained woodlands are areas that have good to extremely good natural drainage. In certain areas, some of these soils tend to be excessively drained and droughty. The main soil types are the Evesboro Series, Rumford Series, and Sassafras Series. These types of soils, which provide both a dry environment for settlement and a multiple of available microenvironmental resources, would be most likely utilized by groups of prehistoric people. A recent survey of existing sites in the Rahoboth Bay area indicated that most prehistoric sites are found on these well-drained woodland soils within approximately 300 feet of a body of water (Wise, 1978a). For this reason, we have outlined in Figure 1 those areas near Indian River and Bay which contain well-drained Woodland soil. These outlined areas should be considered as high potential zones, or areas likely to contain remains of prehistoric sites. Zonal mapping was limited to within approximately one half mile of the Bay and River. This half-mile limit was an arbitrary figure determined as a useful tool for future project planning purposes.

Poorly drained woods and swamps in the area are characterized by areas of poor to extremely poor natural drainage and, in the natural state, would have varying

amounts of water standing on, or just below, the surface for the entire year (Kraft et al. 1975). Major soil types included are Fallsington, Johnston Series, and Osier Series. Major vegetation is almost exclusively water-tolerant plant species such as swamp maple, red maple, gum, cypress, holly, sweetbay, pond pine, willows, alders, and oaks. While these soils provide optimal areas for such animal inhabitants as insects, turtles, snakes, ducks, deer, bear, squirrel, mink, otter, muskrat, turkey and beaver, they usually make unsuitable areas for human habitation. These areas have been outlined on Figure 1 as areas with a low potential for containing remains of prehistoric occupation. Again, this zone has been highlighted only within a half mile of the Indian River and Bay.

Transitional areas in the Indian River and Bay are characterized as having water near the surface during the winter and early spring. These areas are not generally as wet as the poorly-drained woodlands and do not have the good natural drainage of the well-drained woodland areas. Major soil types include Woodstown Series, and Kelis Series. The native vegetation consists of mixed oaks, sweet gum, red maple and scattered pine, but oak is predominant (Kraft et al. 1975). Transitional areas occur between tidal marsh

and well drained woodlands and between well-drained and poorly-drained woodlands.

These areas are not likely to contain a high concentration of prehistoric sites, but it is likely that they may contain sites associated with the exploitation of the edge area between existing zones. For this reason, these areas have been outlined as zones of medium potential on Figure 1 .

HISTORICAL BACKGROUND

Initial contact with Europeans in Delaware probably occurred in 1609 by Henry Hudson as he searched for a passage west. Other contact occurred quickly by Swedish, English and other Dutch explorer/traders. By 1631, a Dutch colony had been established along Delaware Bay.

Possession of parts of Delaware passed between Sweden, Holland and England, depending upon wars in Europe. In 1674, England finally assumed control. Questions were still to occur for the next 100 years over ownership, however, with both the Calverts of Maryland and the Penns of Pennsylvania having claims.

Several boundaries have been established for the southern part of the state. Indian River was frequently used because of the natural boundary it forms. This division is also reflected in the early colonization of the area. Many settlers in southern Sussex County were originally from Virginia or Maryland. Settlers in the north were from Pennsylvania, but considerable overlap occurred. The eventual boundary line dates from 1732, when the Penn heirs seem to have gained the upper hand. The Transpeninsular line, running west from Cape Henlopen, was surveyed in 1751. The north-south boundary, the Mason-Dixon line, was surveyed in

1760. By 1775, the boundaries were fixed and implemented, just prior to the revolution.

Settlement in the Indian River area dates from 1667, when Cruders Neck was patented to Nathaniel Carr. In 1677, Long Neck was patented to William Burton, whose heirs would be influential in the area for generations. By 1692, the Warwick ferry had been established. It ran between Warwick and Piney Neck, south across Indian River. The start of the eighteenth century saw the beginnings of communities in the area such as Dagsboro, Millsboro and Ocean View. Growth and development continued at a slow pace in the Indian River Bay area up to the present.

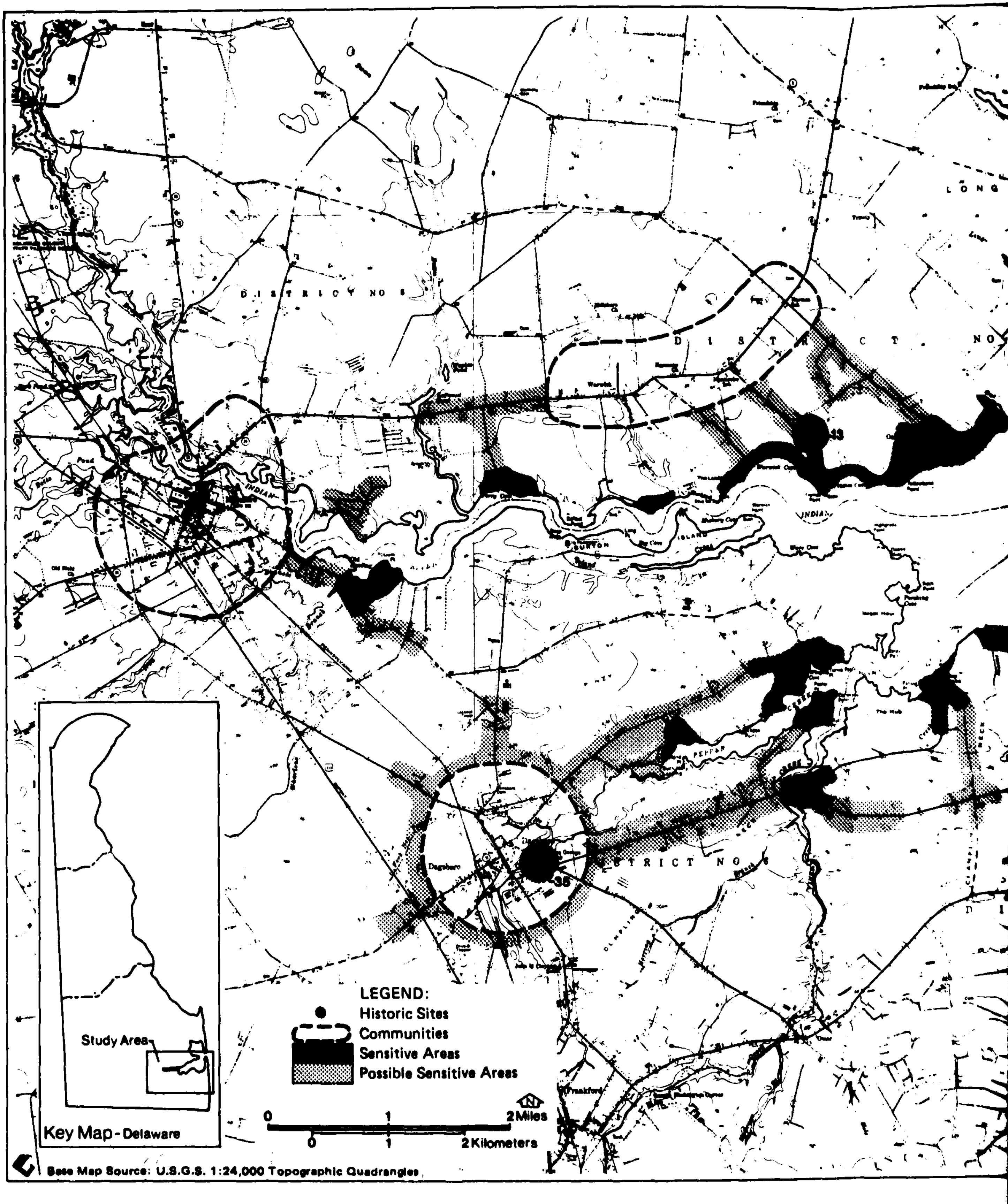
HISTORIC RESOURCES

The area of Indian River and Bay contains several small agriculturally based communities and a variety of rural residential structures. Settled in the late seventeenth century, it has provided a modest subsistence for its residents. Economic changes brought about in the 1920s, such as chicken farming, now dominate the area. Corn and soybeans are major crops. Early twentieth century cottages along the bay are still in use.

Recent changes in the area are obvious. Summer cottages are now year-round residences. Trailer park developments have occurred in several places. While the marginal farming nature of the area remains, retirement and recreation development is quickly becoming a factor in the area.

Four recognized historic sites are located in the general area: White House Farm, an early eighteenth century brick plantation house on the north side of the bay oriented to the river; Prince George Chapel, a mid-eighteenth century wood frame public structure in the community of Dagsboro; Isaac Harmon Farm, a mid-nineteenth century vernacular structure on the Nanticoke Indian community north of the river slightly inland; and Indian River Life Saving Service Station, a late nineteenth century wood frame structure of Victorian design located north of the bay inlet on the Atlantic. Each of these structures is recognized as historically important and adds to the general evaluation of the area by its prototypical nature (see Figure 2 and the Appendix).

In general, the initial settlement in the area related to waterways, since these were the major form of transportation in the area in the seventeenth and early eighteenth century. Plantations appear to be located on raised ground near inlets and the bay. Communities developed



LEGEND:
Historic Sites
Communities
Sensitive Areas
Possible Sensitive Areas
Key Map - Delaware
Study Area
0 1 2 Miles
0 1 2 Kilometers
DISTRICT NO
LONG
INDIAN
PEPPER
CREEK
Dagsboro
Frankford
43
38
Base Map Source: U.S.G.S. 1:24,000 Topographic Quadrangles

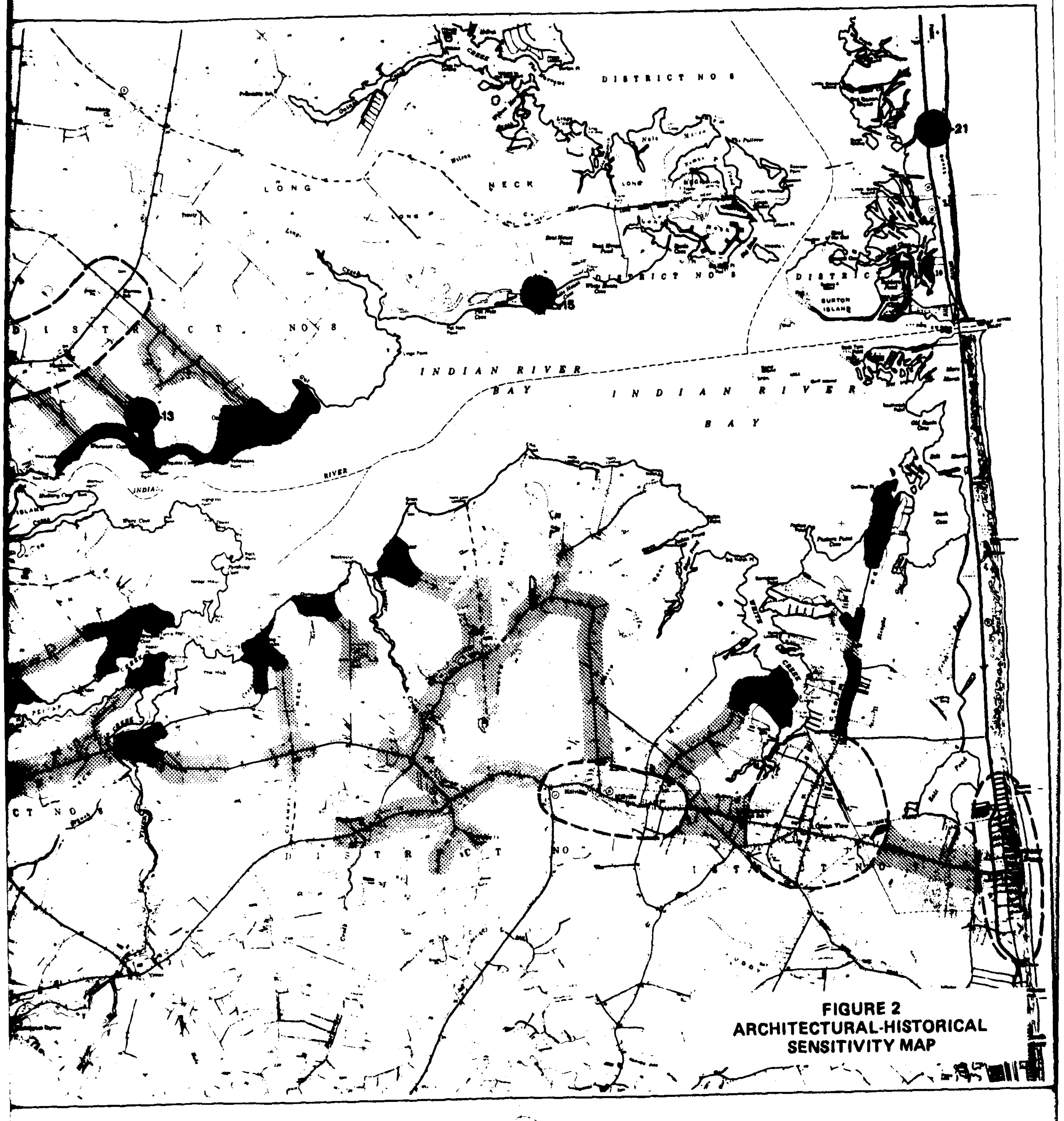


FIGURE 2
ARCHITECTURAL-HISTORICAL SENSITIVITY MAP

inland from the Indian River and Bay. They were still close to the water during the eighteenth century. As farming developed, small settlements occurred further inland. Road systems were developing and of major importance by the nineteenth century. Toward the end of the nineteenth century, resort development occurred along the ocean and went inward along the bay by the early twentieth century. Present growth is intensifying along the bay and ocean in previously undeve oped areas.

Structures in the area are vernacular in design and traditional in use. The plan is generally I- or L-shaped with cypress shingles on wood frame. Stylistic variations are relegated to details and trim, and in all likelihood do not date from when the full style was in vogue.

CONCLUSIONS AND RECOMMENDATIONS

The Indian River and Bay area has retained many elements of its past through economic necessity and tradition. Its history is varied and of importance to the region. Its architecture is restrained and subtle.

Because of field time, property access and the historical nature of some structures which are not easily recognizable in an overview study, it is possible that some sites have been missed in the course of this investigation. Sensitivity mapping has been conducted to show high potential locations of these sites (Figure 2), but this does not imply that nonsensitive mapped areas contain no sites. It is strongly recommended that if a project is expected to impact an area, site-specific reconnaissance of a more intense nature be undertaken.

This overview study of the area's archeological resources, as outlined in the previous sections of this report, shows a distribution of potentially significant sites throughout the entire area. In addition, sensitivity mapping (Figure 1) has identified specific areas that are likely to contain additional sites. While the sensitivity maps show areas of high, low and medium potential, this information should be used for project planning purposes only, and

not as an absolute distribution of archeological resources. It would be necessary to subject each of these zones to rigorous scientific testing in order to test the validity of the distribution mapping.

It is therefore recommended that, when specific project limits in the area have been determined, additional archeological studies be taken beyond the reconnaissance level to determine project impacts and to recommend appropriate mitigation measures.

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APPENDIX E

INSTITUTIONAL ANALYSIS

DELAWARE RIVER DREDGING SPOIL DISPOSAL STUDY

INSTITUTIONAL ANALYSIS

EXISTING INSTITUTIONAL ROLES

For
U.S. Army Corps of Engineers
Philadelphia District

By
Roy F. Weston, Inc.
West Chester, Pennsylvania

Work Order No. 1 – Open-End Planning II
Contract No. DACW61-79-D-0008

March 1979

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DELAWARE RIVER DREDGING SPOIL DISPOSAL STUDY

EXISTING INSTITUTIONAL ROLES

Public institutions represented in the study area which affect or will be affected by the implementation of a regional dredging spoil disposal plan, are identified in this task. This involved Federal, regional, state and local agencies, their legal authority, spatial coverage, functional role, and program responsibilities. The study area for this task is considered to stretch from Trenton to Cape May, on both sides of the Delaware River and Indian River Inlet and Bay. It comprises 13 counties, representing the states of New Jersey, Delaware, and Pennsylvania.

The agencies described are characterized by their respective roles in implementing a number of Federal, as well as state, policies in order to protect the environment from any adverse impact from the dredged spoil-disposal-related activities.

FEDERAL AGENCIES

The major Federal institutions which are directly affected, or will affect the dredging spoil disposal plan are:

1. U.S. Environmental Protection Agency
2. U.S. Army Corps of Engineers
3. U.S. Department of the Interior
    a. U.S. Fish and Wildlife Service
    b. National Park Service
    c. Bureau of Land Management
    d. Heritage Conservation and Recreation Service
    e. Bureau of Mines
    f. U.S. Geological Survey
4. U.S. Department of Commerce
    a. Maritime Administration
    b. National Oceanic and Atmospheric Administration
    c. National Marine Fisheries Service
5. U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control
6. U.S. Department of Housing and Urban Development, Federal Insurance Administration
7. U.S. Department of Transportation
    a. United States Coast Guard
    b. Federal Railroad Administration
    c. Materials Transportation Bureau
8. U.S. Department of Agriculture, Soil Conservation Service

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

The U.S. EPA was established in the Executive Branch as an independent agency on 2 December 1970, through a Presidential Order (Reorganization Plan No. 3 of 1970), reflecting a public commitment to the control and abatement of pollution. The agency is charged with the basic mission of monitoring an integrated, coordinated attack on the environmental problems of air and water pollution, solid waste management, pesticides, radiation, and noise. The agency is further responsible for: 1) conducting research and demonstration, 2) establishing and enforcing standards, 3) monitoring pollution in the environment, and 4) assisting state and local governments in their efforts to control and abate pollution.

The U.S. EPA is a regulatory agency with powers authorized through a number of statues enacted by the Congress. The major ones are discussed in the following paragraphs.

National Environmental Policy Act (NEPA) of 1969

The Act and Executive Order No. 11514 which followed specifically state that the Federal government shall provide leadership in protecting and enhancing the quality of the Nation's environment to sustain and enrich human life. NEPA's national environmental policy requires all Federal agencies and officials to use all practicable means and measures to enhance, preserve, and protect the quality of the environment to the fullest extent possible. Early and

continuing coordination is required to develop a full interchange of views with the Corps of Engineers and appropriate local, state, and Federal agencies and the interested public.

<u>Federal Water Pollution Control Act (PL 92-500)</u>

Section 404 of PL 92-500 concerns the discharge of dredged or fill materials into waters of the United States. The Secretary of the Army and the Administrator of EPA, in conjunction, were to develop guidelines for application. In addition, the Administrator is authorized to prohibit the specification of a disposal site whenever he determines that the discharge of these materials into such areas will have an unacceptable adverse effect on municipal water supplies, shellfish beds and fishing areas, wildlife, or recreational areas. EPA regulations 40 CFR 230.1a(2) have been developed accordingly.

<u>Marine Protection, Research and Sanctuaries Act of 1972</u>

Section 102 of the Act requires that criteria for the issuance of ocean disposal permits be promulgated after consideration of: 1) the environmental effect of the proposed dumping operation, 2) the need for ocean dumping, 3) alternatives to ocean dumping, and 4) the effect of the proposed action on aesthetic, recreational, and economic values, and on other uses of the ocean.

The Act requires the Corps of Engineers to make the same evaluation that is required to the EPA Administrator for ocean dumping of other materials; to make this evaluation by using the open dumping criteria developed by the Administrator. The Act also requires the Corps to utilize ocean dumping sites, that have been designated by the EPA Administrator, to the maximum extent feasible. If the EPA criteria prohibit ocean dumping, the Act requires the Corps to make an independent determination of the need for the proposed dumping based upon an evaluation of the potential effect that would occur to navigation, economic and industrial development, and foreign and domestic commerce of the United States if a permit were denied. No permit may be issued to dump dredged material in the oceans if the dumping does not comply with the EPA criteria, unless the Secretary of the Army seeks a waiver of the criteria from the Administrator after certifying that tnere is no economically-feasible method or site available other than the site under consideration. The Act requires the Administrator to grant this waiver unless he finds that the proposed dumping will result in an unacceptable adverse impact on municipal water supplies, shellfish beds, wildlife, fisheries, or recreational areas.

Protection of Wetlands, Executive Order No. 11990

Through this Executive Order, the President declared wetlands important national resources, warranting specific measures for their

preservation. Prior to issuance of the Executive Order, both the Chief of Engineers and the EPA Administrator had promulgated similar policies and guidelines concerning wetlands in water resource development activities. Guidelines established by EPA are applicable only to those projects and activities involving the discharge of dredged or fill material into waters of the United States. Reviews of activities in wetlands to assess the cumulative effect of activities should be a multiagency effort.

Safe Drinking Water Act of 1974

The Act, which is an amendment to the Public Health Service Act, increases the Agency's authority and responsibility to improve the quality of drinking water and to protect the public health and welfare. EPA is responsible for setting minimum national drinking water regulations to ensure that drinking water is safe. Each state can assume primary enforcement authority over the regulations. If a state does not have primary enforcement authority, EPA will have that authority. The Act also requires EPA to establish regulations for state underground injection control programs in order to protect underground sources of drinking water from contamination.

Other Pertinent Statutes

The dredging spoil disposal study will be indirectly affected by the Clean Air Act Amendments of 1970 which designate EPA as the responsible agency for enforcing standards on emissions which may be

affected by increased traffic and earth-moving activities at proposed sites. Also, the Resource Conservation and Recovery Act of 1976, which supersedes and augments the Solid Waste Disposal Act of 1965 and the Resource Recovery Act of 1970, involves EPA in the dredging spoil disposal through development of alternatives for using spoil material at landfill sites or strip mines. The Act requires a comprehensive Federal-state-local approach to all aspects of waste management, including resource conservation and recovery, land disposal of municipal and industrial wastes, and authorizes a new regulatory program for hazardous wastes.

The Federal Insecticide, Fungicide, and Rodenticide Act of 1947, as amended in 1972 and 1975, which grants EPA the authority to regulate all pesticides, may affect the dredge spoil disposal activities if a proposed site is currently in agricultural use, and there is the potential for runoff to be carried into area streams.

The study area is included within two of the 10 EPA regional offices, namely, Region II for the New Jersey portion of the study area, and Region III covering portions of the study area in Delaware and Pennsylvania.

U.S. ARMY CORPS OF ENGINEERS (CORPS)

As the principal Federal water resource agency, the Corps has been responsible for development and management of the Nation's water resources.

The Federal concern with natural resources is founded on the fact that they are the basis of our national wealth and future well-being. The fundamental goal of Federal participation in resource development is to insure that an optimum contribution is made to the welfare of all the people. The Federal concern regarding water resources is shown by the many legislative enactments by the Congress under the Commerce and Welfare clauses of the Constitution. A developing body of law has established varying degrees of national concern in such areas as navigation, erosion control, flood control, drainage, hydroelectric power generation, irrigation, water supply and water quality. Broad policies related to such objectives as environmental quality, national and regional economic development and social well-being have been developed.

The Department of the Army and the Corps of Engineers are charged by Congress with the major Federal program of water resources development. This has been the outgrowth of legislative and administrative activity over many years. The term "civil works program" is usually applied to these non-military Corps activities. This civil works program involves activities in the following areas of water resource need:

1. Navigation.
2. Flood control.
3. Beach erosion and hurricane protection.
4. Stream bank erosion control.

5. Hydroelectric power.
6. Recreation.
7. Water supply and quality management.
8. Wastewater management.
9. Urban studies.
10. Fish and wildlife.
11. Wetlands conservation.
12. Aquatic plant control.
13. Regulatory functions.
14. Civil works research and development.
15. Activities related to programs administered by other Federal agencies.

Through a variety of nonstructural and structural measures, the Civil Works Program of the Corps of Engineers is the Nation's largest activity for the development, utilization and conservation of its water resources in these areas.

Dams, levees, harbors, waterways and locks provide flood protection, reduce the cost of transportation, supply water for municipal and industrial use, generate hydroelectric power, provide recreational opportunities, regulate the rivers for many purposes, including improvement of water quality and the enhancement of fish and wildlife and protect the shores of oceans and lakes. In addition to designing and constructing these works, the Corps of Engineers is responsible for their operation and maintenance.

The Corps of Engineers addresses the Nation's water resources management problems with full consideration for the environmental implications of its activities. From planning, where it seeks possible nonstructural solutions and least disruptive measures, through construction, where care is taken to prevent or repair any damage to the operation of a project to minimize adverse environmental impact, the Corps seeks to manage the water resources for the benefit of the public while preserving the value of this and related resources.

National goals in water resources management are long-range in nature. Their achievement is of Federal concern, particularly in those aspects of our free enterprise system where effective incentives are lacking. Federal policy seeks to maintain a reasonable balance between the powers and responsibilities assumed by the Federal government and those with the states, local governmental entities, and private enterprise. The civil works program of the Corps emphasizes the need to solve the most pressing problems facing the entire nation as well as those of particular concern to a specific region or locality. The energy crisis precipitated the need to place greater emphasis on hydropower projects as well as transportation and other project functions which contribute to solving energy problems. Urban flood control, municipal and industrial water supply, and commercial navigation are among the high priority functions. Projects emphasizing recreation and those with

unresolved political, environmental or social problems are among the lower priorities. Flood protection for agricultural lands has been among the lower priorities in recent years.

The Corps' activities pertaining to dredging spoil disposal activities is based, or impacted primarily on various sections of the following Acts and regulations:

River and Harbor Act of 1899

It was enacted to protect navigation and the navigable capacity of the nation's waters. Section 10 of the Act, in addition to others, requires permits for various types of work performed in navigable waters, including dredging and stream channelization, excavation, and filling. Any work that is performed outside the limits of a navigable water which affects its navigable capacity may also require a Section 10 permit. On 18 December 1968, the Department of the Army revised its policy with respect to the review of permit applications under Sections 9 and 10 of the 1899 Act, and published in the Federal Register a list of additional factors besides navigation that would be considered in the review of these applications. These factors included; fish and wildlife, conservation, pollution, aesthetics, ecology, and the general public interest.

National Environmental Policy Act (NEPA) of 1969

NEPA's national environmental policy requires all Federal agencies and officials to use all practicable means and measures to enhance, preserve and protect the quality of the environment to the fullest extent possible. Early and continuing coordination is required so as to develop a full interchange of views between the Corps of Engineers and appropriate local, state, and Federal agencies and the interested public. As a result, District engineers will develop, analyze, study, and utilize or adopt all practicable means and measures, including the "no action" alternative and other alternatives to the proposed action, which will enhance, protect, and preserve the quality of the environment, restore environmental quality previously lost, and minimize the mitigate unavoidable adverse effects. In addition, the environment will be analyzed and studied together with engineering, economic, social, and other considerations to insure balanced decision making in the total public interest. In accordance with Section 102(2)(c) of NEPA, environmental statements are required. This document serves as a summation and evaluation of the effects that each alternative action would have on the environment.

Section 1501.7 of the Council on Environmental Quality's implementation of procedural provisions and final regulations to NEPA, as published in the Federal Register on 29 November 1978 (Part VI), established a formal mechanism for agencies in consultation with

affected parties to conduct public scoping meetings to identify the significant issues which must be discussed in detail in an EIS, to identify the issues that do not require detailed study, and to allocate responsibilities for preparation of the document.

Federal Water Pollution Control Act (PL 92-500) Amendments of 1972

Section 404 of PL 92-500 concerns the discharge of dredged or fill material into waters of the United States. The Secretary of the Army, acting through the Chief of Engineers, may issue permits, after notice and opportunity for public hearings for the discharge of dredged or fill material into the navigable waters at specified disposal sites. The Secretary of the Army and the Administrator of EPA, in conjunction, developed guidelines for application. In addition, the Administrator is authorized to prohibit the specification of a disposal site whenever he determines that the discharge of these materials into such an area will have an unacceptable adverse effect on municipal water supplies, shellfish beds and fishing areas, wildlife, or recreational areas. Corps' regulations on the regulatory program 33 CFR 323.4 and 323.5 which are applicable to private projects, state that if EPA guidelines prohibit designation of a proposed disposal, the economic impact on navigation and anchorage of the failure to authorize the use of the proposed disposal site will also be considered in evaluating whether or not the proposed discharge is in the public interest.

Section 313 of PL 92-500 requires each agency of the Federal government engaged in any activity resulting or which may result in the discharge or runoff of pollutants to comply with Federal, state, interstate, and local requirements respecting control and abatement of pollution to the same extent that any person is subject to such requirements. Regulations prescribing policy, practice, and procedure to be followed by Corps of Engineers installations in connection with disposal of dredged material in navigable waters, or transportation of dredged material for the purpose of dumping it on ocean waters are contained in 33 CFR 209.145.

Clean Water Act of 1977 (PL 95-217)

Section 67 modifies Section 404 of PL 92-500 concerning permits for dredged or fill material. The modification specifically subjects Corps dredging projects to state controls in two ways. First, projects involving the discharge of dredged material into water may need state water quality certificates. Second, the law gives states authority to impose their own permit programs and other requirements on Corps of Engineers navigation maintenance dredging projects. It is intended that the Corps will apply for a state permit where one is required, and will make every reasonable effort to comply with state requirements. However, where these requirements cannot reasonably be met, the Corps of Engineers has the authority to proceed with measures necessary

to maintain navigation. The Corps can seek an exemption under Section 404 (r) by submitting an EIS or EIS supplement to Congress in the event a state denies the issuance of a water quality certificate, or EPA exercises a veto under Section 404(c).

Marine Protection, Research, and Sanctuaries Act of 1972

Section 102 of the Act requires that criteria for the issuance of ocean disposal permits be promulgated after consideration of the environmental effect of the proposed dumping operation, the need for ocean dumping, alternatives to ocean dumping, and the effect of the proposed action on aesthetic, recreational and economic values and on other uses of the ocean. The disposal of dredged materials into ocean waters is regulated by the Corps in accorddance with Section 103. The Act requires the Corps of Engineers to make the same evaluation that is required of the EPA Administrator for ocean dumping of other materials, and to make this evaluation, by using the ocean dumping criteria developed by the Administrator. The Act also requires the Corps to utilize ocean dumping sites, that have been designated by the EPA Administrator, to the maximum extent feasible.

If the EPA criteria prohibit ocean dumping, the Act requires the Corps to make an independent determination as to the need for the proposed dumping based upon an evaluation of the potential

effect that would occur to navigation, economic and industrial development, and foreign and domestic commerce of the United States if a permit were denied. An independent determination as to other proposed methods of disposal of dredged materials and appropriate locations for ocean dumping must also be made by the Corps in review of applications for ocean dumping.

No permit may be issued to dump dredged material in the oceans if the dumping does not comply with the EPA criteria unless the Secretary of the Army seeks a waiver of the criteria from the Administrator after certifying that there is no economically-feasible method or site available other than the proposed site. The Act requires the Administrator to grant this waiver unless he finds that the proposed dumping will result in an unacceptable adverse impact on municipal water supplies, shellfish beds, wild-life, fisheries, or recreational areas.

Coastal Zone Management Act of 1972 (PL 92-583)

The Act establishes a national policy to preserve, protect, develop, and, where possible, restore or enhance the resources of the coastal zone of the United States. It provides for monetary assistance to the states to facilitate utilization of coastal zone resources, coupled with adequate protection of the coastal zone environment, through development and implementation of state-wide comprehensive Coastal Zone Management (CZM) programs. Section 307 mandates Federal interagency coordination and cooperation in concert with

state coastal zone management programs. Federal agencies must cooperate and actively participate with state and local governments and regional agencies towards achieving integrated policy and action proposals at all levels of government. Future Corps actions should be consistent, to the maximum extent feasible, with the state's approved CZM programs and plans. The Corps' traditional area of regulatory jurisdiction overlaps and interacts with state CZM agency policies. Close and continuing coordination is required between the Corps and state CZM agencies to insure that issuance of permits is in conformity with the state CZM plans.

Fish and Wildlife Coordination Act of 1958

The Act states the general policy that fish and wildlife conservation shall receive equal consideration with other project purposes and be coordinated with other features of water resources development programs. Adverse effects on fish and wildlife resources and opportunities for improvement of fish and wildlife shall be examined along with other purposes which might be served by water resource developments. All pre-authorization and post-authorization planning on project development is to be coordinated with the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, and the agencies administering the fish and wildlife resources of the State where construction is contemplated. As a result, each District Engineer must include in reports an account of the steps taken to coordinate with the Federal and

state fish and wildlife agencies, and specifically accept, modify, or reject each recommendation. In cases where differences cannot be reconciled, clearly state reasons why and present analyses to support the District's position. Accordingly, the advice and recommendations of the fish and wildlife agencies will be requested and adopted to the fullest extent practicable in project evaluation.

Protection of Wetlands, Executive Order No. 11990

In Executive Order 11990, the President declared wetlands important national resources warranting specific measures for their preservation. Prior to issuance of the Executive Order, both the Chief of Engineers and the EPA Administrator had promulgated similar policies and guidelines concerning wetlands in water resource development activities. The Chief of Engineer's policies are applicable to all Corps projects, or proposed projects, impacting on wetlands. Basically this policy states that unnecessary alteration or destruction of wetlands should be discouraged as contrary to the public interest. Reviews of activities in wetlands to assess the cumulative effect of activities should be a multiagency effort. Proposed activities in wetlands must demonstrate that benefits outweigh the damages to wetland resources. Also, evaluations of the availability of feasible alternative sites must be shown.

Coupled with Section 404 guidelines and the Fish and Wildlife Coordination Act, the Executive Order all but eliminates use of anything but a very small marsh fringe within a disposal area.

The Corps could be required to provide protective surrounding dikes for the marsh area and special drainage emphasis which could raise construction costs and reduce disposal capacity.

As an additional item, Section 150 of the Water Resources Development Act of 1976 authorizes the Chief of Engineers to plan and establish wetland areas as part of authorized water resources development projects under his jurisdiction. The costs for such wetlands is not to exceed $400,000, and the benefits are assumed to at least equal the costs. All future water resource development project reports are to include consideration of the establishment of wetlands.

Flood Plain Management, Executive Order No. 11988

This Order is based, in part, on NEPA and adds new prominence to the environmental aspects of flood plains. Federal agencies are required, during the decision-making process, to recognize significant public values of flood plains and to consider the public benefits that will be derived from their restoration and preservation. The objective is to avoid, to the extent possible, the long- and short-term adverse impacts associated with occupancy and modification of flood plains, and to avoid direct and indirect support of flood plain development wherever there is a practicable alternative.

If there is no practicable alternative to locating an action in a flood plain, Section 2(a)(2) of the Order requires the agency to prepare a public notice and circulate it to the general public with: 1) a description of why the action must be located in the flood plain; 2) significant facts considered in making the determination to locate in the flood plain, including alternative sites and actions considered and any tradeoffs that were made; and 3) a statement indicating whether the proposal conforms to applicable state or local flood plain protection standards. Section 2(a)(3) requires the submission of a notice to state and areawide A-95 clearinghouse for the geographic area affected, when an action is to be located in a flood plain.

If the proposed Corps' action is located in a flood plain, Section 2b of the Order requires the Corps, in their transmittal to the Office of Management and Budget for new authorizations or new appropriations for the action, to include: 1) statements on whether the action affects the natural and beneficial values of the flood plains; 2) steps taken to minimize potential harm to or within the flood plain caused by the action; and 3) steps taken to restore and preserve the natural and beneficial flood plain values of the flood plain area.

Water Resources Development Act of 1976

Section 148 of the Act states that the Corps shall utilize appropriate management practices to extend the capacity and useful life

of dredged material disposal areas such that the need for new dredged material disposal areas is kept to a minimum. The management practices are to include construction of dikes, consolidation and dewatering of dredged material, and construction of drainage and outflow facilities.

Local Cooperation in Corps Projects

Section 2 of the Flood Control Act of 1936 (PL 738) prescribed among other things, "that, hereafter, Federal investigations and improvements of rivers and other waterways for flood control and allied purposes shall be under the jurisdiction of and shall be prosecuted by the Army Department under direction of the Secretary of Army and supervision of the Chief of Engineers." Section 3 of the Act stipulated that local interests should: 1) provide without cost to the United States all lands, easements and rights-of-way necessary for the construction of the project, except as otherwise provided herein; 2) hold and save the United States free from damages due to the construction works; and 3) maintain and operate all the works after completion in accordance with regulations prescribed by the Secretary of the Army.

The local cooperation by the Act also requires the local interests to provide, without cost to the United States, relocations necessary for the construction, and subsequent operation and maintenance of the project, including suitable areas determined by the Chief of

Engineers to be required in the general public interest for initial and subsequent disposal of spoil and necessary retaining dikes, bulkheads, and embankments therefore, or the costs of such retaining works. Also to accomplish without cost to the United States, all alterations and relocations of highway bridges, buildings, streets, storm drains, utilities, and other structures and improvements.

On 17 July 1978, the Director of Civil Works issued EC 1130-2-161, a blanket policy statement concerning diking. The statement presented the view that the provision of disposal areas by the local sponsor implied the requirement of suitability. The definition of suitability has been interpreted to mean being utilized adversely, affecting the environment of the surrounding waterway. With this interpretation it is the position of OCE that all diking costs are the responsibility of the local sponsor.

Disposal Area Acquisition

As the areas in the vicinity of repetitive shoal areas were consumed, and as real estate values rose, fulfilling the requirement for new disposal areas for maintenance dredging by no-cost easement became impossible. In view of this, and in order to avail the Federal government the return from land enhancement which frequently occurs from filling marginal lands, the Philadelphia District Engineer in 1965 proposed fee acquisition of two disposal areas required in

order to insure that dredging could be accomplished at the most economical cost. However, because of public resentment, and official (state and local) opposition, the District Engineer was instructed to abandon the proposed fee acquisition. In 1966, the Office of the Chief of Engineers acknowledged that proposed disposal areas must have maximum public acceptability, and the right of the Federal government to use "eminent domain" would not be relied on. The policy necessitates obtaining disposal areas by other than fee acquisition.

U.S. DEPARTMENT OF THE INTERIOR

Various offices under this Department will be involved in the Corps' navigation maintenance dredging projects, the major ones being the U.S. Fish and Wildlife Service, National Park Service, Bureau of Land Management, Bureau of Outdoor Recreation, Bureau of Mines, and Geological Survey. The Department of Interior was created by act on 3 March 1849, and being the Nation's principal conservation agency, it has responsibility for most of the nationally-owned public lands and natural resources. This includes fostering the wisest use of the land and water resources, protecting the fish and wildlife, preserving the environmental and cultural values of national parks and historical places, and providing enjoyment of life through outdoor recreation.

In fulfilling these duties, the Department offices execute varying roles in implementing the various Federal regulations such as:

the Fish and Wildlife Coordination Act of 1958, National Environmental Policy Act of 1969, the Federal Water Pollution Control Act (PL 92-500), and the Marine Protection, Research and Sanctuaries Act of 1972. (These Acts are explained under the previous section, "U.S. Army Corps of Engineers," towards their effect on the Corps' dredging projects.)

U.S. Fish and Wildlife Service

Reorganized by the Fish and Wildlife Act, and renamed by Congress in April 1974, the Service is responsible for wild birds, mammals, inland sport fisheries, and specific fishery research activities. The Service provides leadership for the protection and improvement of land and water environments (habitat preservation) which directly benefits the living natural resources. The various activities include: biological monitoring, environmental impact assessment through river basin studies, including stream channelization, dredge and fill permits, and environmental impact statement review; and area planning and preservation. The Service is one of the key Federal agencies involved in the implementation of the Fish and Wildlife Coordination Act of 1958.

National Park Service

Established in the Department of Interior on 25 August 1916, the Service administers an extensive system of national parks, monuments, historic sites, and recreation areas. It assists states, local

governments, and citizen groups in the development of park areas, the protection of the natural environment, and the preservation of historic properties. The effect of the dredging spoil disposal plan on these environmentally-sensitive elements will be reviewed by the National Park Service, and its findings submitted to the Corps for protecting these sensitive elements of nature.

Bureau of Land Management (BLM)

Established on 16 July 1946 by the consolidation of the General Land Office and the Grazing Service by provisions of Presidential Reorganizational Plan 3 of 1946, the Bureau is responsible for the total management of 473 million acres of public lands located primarily in the Far West and Alaska. The Federal Land Policy and Management Act of 1976 establishes policy guidelines and criteria for the management of public lands and resources. The basic resources which may be affected by the Corps' project, and over which the Bureau has resources management authority include timber, minerals, wildlife habitat, endangered plant and animal species, livestock forage, recreation and cultural values, designated conservation and wilderness areas, and scenic rivers. Bureau programs provide protection, orderly development, and use of the national lands and resources under principles of land use planning, public participation, multiple use, and sustained yield. In the public interest the Bureau makes land available for Federal agencies under certain conditions.

Heritage Conservation and Recreation Service

This Service, originally called the Bureau of Outdoor Recreation, was created on 2 April 1962, and is responsible, by the Act of May 1963, for promoting coordination and development of effective programs relating to outdoor recreation. Under the Land and Water Conservation Fund Act of 1965, the Bureau participates directly in the planning, coordination, and establishment of uniform policies relating to recreation and fish and wildlife benefits and costs of Federal water resource projects. Under the Department of Transportation Act, the possible adverse effects of transportation projects and programs on parks, recreation areas, and wildlife and waterfowl refuges are reviewed. Another important role of the Bureau, under the National Environmental Policy Act of 1969, is to review Federal actions having an impact on outdoor recreation.

Bureau of Mines

This Bureau was established in the Department of Interior on 1 July 1910 by the Organic Act of 16 May 1910. Although not directly affected, the Bureau can participate in the review of alternative plans for using the dredge spoil in used-up mines. The Bureau's activities, including the applied and basic research to develop the technology for the extraction, processing, use, and recycling of the mineral resources at reasonable cost without harm to the environment or the workers involved, may help in deciding alternative plans for handling and dredged spoil.

U.S. Geological Survey

The U.S. Geological Survey was established by the Act of 3 March 1879, which provided for "the classification of the public lands and the examination of the geological structure, mineral resources, and products of the national domain." Congressional and Executive direction later expanded the Survey's authority and responsibilities to include topographic mapping; chemical and physical research, stream-gauging, and water supply assessments; supervision of mineral explorations and development activities on Federal and Indian lands; engineering supervision of water power projects; and administration of a minerals exploration program. For the Corps' navigation maintenance dredging proposals, the Survey can provide basic data and services with regard to establishing existing conditions.

U.S. DEPARTMENT OF COMMERCE

The Department was designated as such by the Act of 4 March 1913, reorganizing the Department of Commerce and Labor. The Department encourages, serves, and promotes the Nation's economic development and technological advancement. It provides: 1) social and economic statistics and analyses (through Bureau of the Census, etc.), 2) assists in the development and maintenance of the U.S. Merchant Marine (by Maritime Administration), 3) provides research for and promotes the increased use of science and technology in the development of the economy, and 4) seeks to improve the understanding of the Earth's physical environment and oceanic life (through the National Oceanic and Atmospheric Administration, etc.).

Maritime Administration

The Maritime Administration was established by Reorganization Plan 21 of 1950. It administers programs to aid in the development, promotion, and operation of the U.S. Merchant Marine. It is also charged with organizing and directing emergency merchant ship operations. Among many programs administered by the Maritime Administration toward helping the operation of merchant ships, the Administration conducts programs to develop ports, facilities, and intermodal transport, and to promote domestic shipping.

National Oceanic and Atmospheric Administration (NOAA)

The NOAA was formed by the Reorganization Plan 4 of 1970. The mission of NOAA is to: 1) explore, map, and chart the global ocean and its living resources, 2) manage, use, and conserve those resources, 3) predict conditions in the atmosphere, ocean, sun, and space environment, 4) issue warnings against impending destructive natural events, 5) develop beneficial methods of environmental modification, and 6) assess the consequences of inadvertent environmental modification.

The function of NOAA in the dredge spoil disposal activities is mainly from its principal functions of providing weather forecasts; issuing warnings against such destructive natural events as hurricanes, tornadoes, and floods; and providing special services in support of marine activities, urban air-quality control, and other weather-sensitive activities. NOAA prepares and issues nautical

and aeronautical charts, provides precise geodetic surveys, and predicts tides, currents, and the state of the oceans. NOAA also analyzes economic aspects of fisheries operations, conducts research and development aimed at providing alternatives to ocean dumping, and provides Federal leadership in promoting wise and balanced management of the Nation's coastal zone, including awarding grants to states for developing and carrying out plans for the management of their coastal zones. The Coastal Zone Management Act of 1972 (PL 92-583) involves NOAA as the lead agency in the coordinating and cooperating effort in the state-wide coastal zone management programs. (The discussion of the Act is included in the section, "U.S. Army Corps of Engineers.")

The National Marine Fisheries Service (NMFS) is one of the field organizations under NOAA, which conducts biological research and surveys of the living resources of the sea, analyzes economic aspects of fisheries operations with an eye to improving man's ability to use and conserve those resources, and protects marine mammals. The National Marine Fisheries Service is one of the key Federal agencies involved in the implementation of the Fish and Wildlife Coordination Act of 1958. All pre- and post-authorization planning on project development (navigation maintenance dredging projects) is to be coordinated with the U.S. Fish and Wildlife Service, the NMFS, and the agencies administering the fish and wildlife resources of the state where construction is contemplated.

Also, the Federal Water Pollution Control Act involves this agency in the process of identifying adverse effects on the shellfish beds and commercial fishing areas from the Corps' project development.

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE (HEW) PUBLIC HEALTH SERVICE, CENTER FOR DISEASE CONTROL

The Public Health Service was created in 1798, and the Public Health Service Act of 1 July 1944 consolidated and revised substantially the previous legislation creating the Service. The various responsibilities of the Service include providing national leadership for the prevention and control of communicable and other diseases. This function is carried out by the Center for Disease Control which was established as an operating health agency within the Public Health Service on 1 July 1973. The Center administers national programs for the prevention and control of communicable and vector-borne diseases and other preventable conditions, including urban rat control and childhood lead-based paint poisoning.

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT (HUD), FEDERAL INSURANCE ADMINISTRATION (FIA)

HUD was created by the Department of Housing and Urban Development Act of 9 September 1965, and is the principal agency responsible for programs concerned with housing needs and improving and developing the Nation's communities. The FIA is one of the agencies

under HUD, responsible for administering three Congressionally-mandated property insurance programs, namely, flood insurance, riot reinsurance, and crime insurance. The National Flood Insurance Program is designed to provide Federally-subsidized flood insurance at affordable rates to property owners in flood, mudslide (mudflow), or flood-related erosion-prone areas. In conjunction with other Federal agencies, state and local governments, and the private insurance industry, the FIA also studies insurance availability problems and makes recommendations regarding various options for resolving such problems.

The FIA has adopted the 100-year flood as the standard for the identification of special flood hazard areas and as the base flood elevation for the adoption of local land use controls. FIA delineates the 100-year flood line in communities joining the Flood Insurance Program, and also those potentially endangered (flood prone) communities which may not have entered the program on their own initiative. The regulations pertinent to FIA programs are discussed in the following paragraphs.

Flood Plain Management, Executive Order No. 11988

Federal agencies are required, during the decision-making process, to recognize significant public values of flood plains and to avoid, to the extent possible, the long- and short-term adverse impacts associated with occupancy and modification of flood plains and to

avoid direct and indirect support of flood plain development wherever there is a practicable alternative.

Flood Disaster Protection Act of 1973

The Act requires that Federal or Federally-related financial assistance (including disaster assistance, FHA or VA insurance loans, and mortgage loans from Federally-supervised lending institutions) for acquisition or construction purposes in areas of special flood hazard in participating communities be protected by flood insurance. Section 202(a) of the Act stipulates that no Federal officer or agency shall approve any financial assistance for acquisition or construction purposes on and after 1 July 1975, for use in any area that has been identified by the Secretary (of HUD) as an area having special flood hazards unless the community in which such area is situated is then participating in the national flood insurance program.

National Flood Insurance Act of 1968

Although parts of this Act have been revised or repealed by sections of the Flood Disaster Protection Act of 1973, Section 1316 does have direct effect on the dredge spoil disposal activities. Section 1315 states that "no new flood insurance coverage shall be provided under this title for any property which the Secretary finds has been declared by a duly constituted state or local zoning authority, or other authorized public body, to be in violation of

state or local laws, regulations, or ordinances which are intended to discourage or otherwise restrict land development or occupancy in flood-prone areas."

The FIA responsibilities for the study area are administered by FIA Region II (New Jersey portion of the study area) and FIA Region III (Delaware and Pennsylvania portions of the study area).

U.S. DEPARTMENT OF TRANSPORTATION (DOT)

The U.S. DOT was established by the Act of 15 October 1966 "to assure the coordinated, effective administration of the transportation programs of the Federal Government," and to develop "national transportation policies and programs conducive to the provision of fast, safe, efficient, and convenient transportation at the lowest cost consistent therewith." The navigation projects directly or indirectly involve a number of operating administrations under this Department, namely the U.S. Coast Guard, Federal Highway Administration, Federal Railroad Administration, and the Materials Transportation Bureau.

U.S. Coast Guard

Established by the Act of 28 January 1915, it became a component of the U.S. DOT pursuant to the Department of Transportation Act of 1966. The Coast Guard is a branch of the Armed Forces of the United States at all times, and is a service within the Department of

Transportation except when operating as part of the Navy in time of work or as directed by the President. Under its functions of saving life and property in and over the high seas and the navigable waters of the U.S., it is involved in flood relief, and removing hazards to navigation.

It is responsible for enforcing Federal laws governing navigation, vessel inspection, port safety and security, marine environmental protection, and resource conservation. It cooperates with other agencies in the execution of their law enforcement responsibilities, in its capacity as the primary maritime law enforcement agency for the United States. The Coast Guard is involved in navigation through its programs such as the marine environmental protection, and aids to navigation.

Federal Railroad Administration (FRA)

The FRA consolidates Federal government support of rail transportation activities. It exercises jurisdiction over all areas of rail safety under the Rail Safety Act of 1970, such as track maintenance and inspection standards. The Administration may be involved in the Corps' dredge spoil disposal program if the project requires hauling equipment and dredge spoil materials by railroad, and the transportation route (by road) or if the proposed disposal sites interfere with the existing or proposed railroad system in the area.

Materials Transportation Bureau

The Bureau was established in July 1975, to coordinate U.S DOT's increasing overall operational responsibilities concerning hazardous materials transportation and pipeline safety. Responsibilities of the Bureau include all operational pipeline safety functions and those hazardous materials operational functions pertaining to regulation and exemptions, and those functions of an intermodal nature. One of the alternatives of transporting the dredge spoil material is through pipelines; also based on the safety characteristics of the dredged material, the Bureau may become involved in its safe handling from the dredging area to the disposal site.

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE (SCS)

The SCS was established in the U.S. Department of Agriculture by the Congress under the authority of the Soil Conservation Act of 1935, to plan and carry out a national program to conserve and develop the nation's soil and water resources. Among the many responsibilities and functions of SCS are: 1) to develop and carry out a national soil and water conservation program through conservation districts; 2) watershed protection and flood prevention projects and river basin investigations with other agencies; 3) help local sponsors develop and carry out multicounty resource conservation and development projects; 4) help develop USDA's conservation cost-sharing programs; 5) primary responsibility for the national cooperative soil survey; 6) implement

the national land inventory and monitoring activity; 7) appraise potential for outdoor recreation development, and 8) help establish recreation areas on privately-owned land and in public water-based recreation and fish and wildlife areas in watershed protection and resource conservation and development projects; 9) technical assistance to land users participating in the conservation credit program of the Farmer's Home Administration; and 10) technical assistance to communities and units of government on land use planning, and help them in obtaining the needed technical data on land, water, and related resources.

SCS programs requiring knowledge and use of many engineering disciplines include: 1) planning and site selection; 2) designing and constructing systems and structures to control erosion and runoff; 3) reducing flooding and sedimentation; 4) providing water supply for municipal, industrial, agricultural, and recreational uses; 5) removing excess water; 6) applying irrigation water; 7) disposing of, and recycling agricultural wastes; and 8) abating pollution.

SCS helps individuals and groups mainly through conservation districts organized under state law. These districts are legally responsible for soil and water conservation work within its boundaries (usually a county). The dredge spoil disposal plans will

involve SCS and its state counterparts through land treatment programs to reduce sedimentation, and if the use of any site generates the potential for soil erosion and transporting of sediments into area streams.

REGIONAL AGENCIES

The major regional agencies, of multicounty and multistate structure, which will play a role in the dredging spoil disposal study are:

1. Delaware River Basin Commission (DRBC).
2. Delaware Valley Regional Planning Commission (DVRPC).
3. Wilmington Metropolitan Area Planning and Coordinating Council (WILMAPCO).
4. Delaware River and Bay Authority (DRBA).
5. Delaware River Port Authority (DRPA).

DELAWARE RIVER BASIN COMMISSION (DRBC)

The DRBC is the mechanism that was created by interstate-Federal compact in 1961 to establish coordinated multipurpose regional planning, management, and protection of the four-state valley's abundant water resources. The river basin encompasses portions of the states of Delaware, New Jersey, New York, and Pennsylvania. Under the provisions of the DRBC Compact, the Commission is charged with planning, developing, managing, and protecting the 13,000-square mile valley's water resources from Cape May and Cape Henlopen to the Catskill Mountains. Its multipurpose scope encompasses pollution control, water supply, flood control, water-based recreation, fish and wildlife protection, and other phases of water management, except navigation.

The Commission's role in recent years is toward a more coordinating and service role in water resource management and pollution control, coordinating and reformulating water quality standards, developing better monitoring programs with the Compact parties, and on occasion, sitting as a board of arbitration when interstate concerns are involved in specific pollution programs.

The Commission retains general review authority over major projects within the basin. Article 11 of the Compact requires that the planning of all projects related to powers delegated to the Commission be undertaken in consultation with the Commission. DRBC works with the U.S. Department of Housing and Urban Development's flood insurance program, promulgating flood plain regulations to forestall undesirable flood plain development in the future. It assumes an active role of environmental analysis, including continuous cooperation with Federal agencies, and with the states. DRBC prepares detailed critiques of draft environmental impact statements of other lead agencies, and in some instances, its own EIS's in compliance with NEPA.

Section 11.1 of the Compact specifies that all projects related to powers delegated to the Commission by this Compact shall be undertaken in consultation with the Commission. Thus, in the dredging and filling projects DRBC will be involved as a review agency on a number of issues associated with the project activities

and involving Federal regulations, such as the National Environmental Policy Act of 1969, the Federal Water Pollution Control Act, Clean Water Act of 1977, Fish and Wildlife Coordination Act of 1958, and the Flood Plain Management - Executive Order No. 11988. In fact, DRBC is the sponsoring agency for this dredging spoil disposal study. Previously, water quality certificates for maintenance dredging were issued by DRBC; this authority now rests with the states.

Through the adoption of the Wetlands Protection Policy as part of the Comprehensive Plan, DRBC's policy will be to support the preservation and protection of wetlands and to minimize alterations in the quantity or quality of the underlying soils and natural flow of waters that nourish wetlands. DRBC will also safeguard against adverse draining, dredging or filling practices, solid waste management practices, siltation, or the addition of pesticides, salts or toxic materials arising from nonpoint source wastes, and through destructive construction activities. The Commission will undertake review and action on projects affecting 25 or more acres of wetlands; projects affecting less than 25 acres may be subject to Commission review and action: 1) where no state or Federal level review and permit system is in effect; 2) where the Executive Director (DRBC) determines that the project is of major regional or interstate significance requiring action by the Commission; or 3) when a Commissioner or the Executive Director determines that

the final action of a state or Federal permitting agency may not adequately reflect the Commission's policy as to wetlands of the Basin.

DELAWARE VALLEY REGIONAL PLANNING COMMISSION (DVRPC)

First established as a regional planning agency in June 1965, DVRPC achieved full legal status in 1967 by virtue of an interstate compact approved by the legislatures of Pennsylvania and New Jersey. The region includes: the Pennsylvania counties of Bucks, Chester, Delaware, and Montgomery; the New Jersey counties of Burlington, Camden, Gloucester, and Mercer; and the cities of Philadelphia, Chester, Camden, and Trenton. The purpose of the agency is to develop and promote comprehensive plans for the region to guide the Federal, state, and local governments investing funds in public facilities so that these funds will be used wisely, duplications avoided, and agreement sought on points of conflict.

DVRPC is an areawide (metropolitan) clearinghouse through the Federal OMB Circular No. A-95 (Revised). Under Section 204 of the Demonstration Cities and Metropolitan Development Act of 1966, the agency has to review and comment upon applications from local and state governments for Federal grants to finance their capital improvement projects, such as highways, mass transit, sewers, water recreation, health, and airport facilities. DVRPC serves as an advisory agency to local and state governments in the

region, while the actual authority for carrying out its plans continues to rest in the governing bodies of the states and local agencies.

DVRPC's work program involves: 1) the preparation, updating, and refinement of regional plans for highways, mass transit, land use, open space, water facilities, and housing; 2) study of regional problems related to the economy, energy, airports, etc.; 3) review of applications for grants-in-aid for local development projects; and 4) the collection, coding, and storage of a wide variety of regional data and maps.

Any Federal plans and projects will be reviewed by the Commission pursuant to Section 102(2)(c) of the National Environmental Policy Act of 1969, and any agency comments will accompany the EIS submitted by the Federal agency.

WILMINGTON METROPOLITAN AREA PLANNING AND COORDINATING COUNCIL (WILMAPCO)

WILMAPCO was established in 1968 to comply with a Federal requirement for future grants-in-aid which are channelled through the U.S. Department of Housing and Urban Development. It is a compact consisting of voting members representing the counties of New Castle, Delaware; Salem, New Jersey; and Cecil, Maryland; and the cities of Wilmington and Newark in Delaware.

The objective of the Council is to prepare and update a comprehensive land use plan for the metropolitan area. Such a plan is required before local governments and counties are eligible to receive Federal assistance for water and sewer systems, open space programs, etc. It helps to coordinate the various city and county land use plans to insure compatibility, especially along border areas. The Council combines the County Land Use Plans into a Regional Land Use Plan, and updates changes annually.

WILMAPCO acts as the regional clearinghouse for Federally-funded projects which could have a significant impact on area and community development. It reviews each project for its environmental impact and its consistency with regional plans and policies. In addition, it acts as a clearinghouse for comments from local government and planning agencies. The agency will be involved in protecting the environment through its reviewing authority resulting from Federal as well as state regulations relating to any Federally-funded project.

DELAWARE RIVER AND BAY AUTHORITY (DRBA)

The Delaware River and Bay Authority was organized in 1963 by enabling legislation in the states of Delaware and New Jersey, and the Federal government, for purposes of planning, financing, developing, construction, purchase, lease, maintenance, improvement, and operation of crossings between the states of Delaware

and New Jersey across the Delaware River and Bay. The agency is involved in conducting a long-range study of economic and transportation development programs that may help the future development of the Delaware River and Bay.

DELAWARE RIVER PORT AUTHORITY (DRPA)

DRPA was created in 1951 as successor to the Delaware River Joint Commission by compact legislation between New Jersey and Pennsylvania, and approved by the U.S. Congress in 1952. It owns and operates four bridges which are vital highway links connecting southeastern Pennsylvania and southern New Jersey. It owns, and through its subsidiary, PATCO (Port Authority Transit Corporation), operates a new modern transit system (the 14.5-mile Lindenwold High Speed Line) serving suburban Camden County and center-city Philadelphia, and it conducts an aggressive program of port promotion to expand maritime commerce and boost regional employment.

Promoting the growth of maritime trade is one of the responsibilities assigned to DRPA in the Compact; this responsibility is carried out by the Authority's World Trade Division.

The Authority's Regional Planning Office works closely with DVRPC to coordinate agency programs and participates in DVRPC's technical planning activities in the field of regional transportation.

STATES

The states representing the study area are the states of New Jersey, Delaware, and the Commonwealth of Pennsylvania. The major agencies which may directly or indirectly be involved or affected by the dredging spoil disposal plans are as follows:

1. New Jersey
   a. Department of Environmental Protection
   b. Department of Agriculture
   c. Department of Community Affairs
   d. Department of Transportation
   e. State Budget Office

2. Delaware
   a. Department of Natural Resources and Environmental Control
   b. Department of Health and Social Services, Division of Public Health
   c. Department of Transportation, Division of Highways
   d. Department of Community Affairs and Economic Development
   e. Solid Waste Authority
   f. Office of Management, Budget and Planning

3. Pennsylvania
   a. Department of Environmental Resources
   b. Pennsylvania Fish Commission
   c. Department of Transportation
   d. Department of Commerce, Navigation Commission

e. Department of Community Affairs

f. Office of the Budget

NEW JERSEY

New Jersey--Department of Environmental Protection (DEP)

The N.J. DEP was created in 1970 to conserve, restore, and enhance the physical environment of the state. It is responsible for the protection of the state's forests, water, land, air, wildlife, and shellfish resources, and outdoor recreational opportunities. DEP is the branch of the New Jersey state government directly responsible for ensuring the maintenance of a quality environment in New Jersey, similar to EPA at the Federal level. The Department, through its various divisions and bureaus, is responsible for administering various Federal laws and state policies that regulate certain types of activities within the state. Some of these regulations are discussed in the following paragraphs.

Federal Policies

1. National Environmental Policy Act of 1969

The Act and Executive Order No. 11514 specifically state that early and continuing coordination is required between the Corps and the appropriate state agencies, to develop a full interchange of views on protecting and enhancing the quality of the Nation's environment to sustain and enrich human life.

2. Clean Water Act of 1977 (PL 95-217)

Section 67 modifies Section 404 of PL 92-500 (Federal Water Pollution Control Act) concerning permits for dredged or fill material. The modification specifically subjects Corps maintenance dredging projects to state controls in two ways. First, projects involving the discharge of dredged material into water will need state water quality certificates. Second, the law gives states the authority to impose their own permit programs and other requirements on Corps' navigation maintenance dredging projects. It is intended that the Corps will apply for a state permit where one is required, and will make every reasonable effort to comply with state requirements. Thus, the Act stipulates the requirement for a state water quality permit for each disposal site, and possible requirement for a discharge permit from the state.

3. Coastal Zone Management Act of 1972 (PL 92-583)

Salient features of the Act in relation to the state are given in the section, "U.S. Army Corps of Engineers." In addition, a number of state policies are also implemented through the divisions of DEP, the prominent ones being: the Wetlands Act of 1970, Coastal Area Facility Review Act (CAFRA), and the Riparian Statutes.

State Policies

The Wetlands Act of 1970 requires that anyone wishing to dredge, remove fill, or otherwise alter or pollute the coastal wetlands must first obtain a permit from the DEP. The Coastal Area Facility

Review Act (CAFRA) of 1973 contains a long list of types of facilities for which application to the DEP must be made before they can be constructed within the statutorily-defined "Coastal Area." The list includes among others, roads, parking facilities, sanitary landfills, housing, marine terminals and cargo-handling facilities, storage facilities, and electric power generation. The Riparian Statutes address riparian lands defined as lands now or formerly flowed by the tides. Under the doctrine of riparian rights, these lands belong to the state. An individual or municipality wishing to develop or improve these lands in any way must receive the approval of the Natural Resource Council to buy or lease the tidelands from the state. If the Natural Resource Council makes a real estate decision inconsistent with the Coastal Program, the Commissioner of DEP will block the Council decision. DEP has the authority to approve, condition, or deny the Waterfront Development Permit applications.

The following divisions within the DEP are directly or indirectly involved with the dredge spoil disposal activities.

Division of Marine Services

This division is responsible for maintaining and improving the state's inland freshwater lakes; streams, bays, ocean front and nontidal waterways; installing navigational aids; and operating a number of marinas. The Division's Office of Riparian Lands

Management administers the waterfront development permit and riparian real estate programs, and the Office of Wetlands Management administers the wetlands permit program.

Division of Water Resources

This Division is responsible for water quality planning and maintenance, and flood plain management. The Division is the designated water quality planning agency under Section 208 of the Federal Water Pollution Control Act, and under the New Jersey Water Pollution Control Act. It has the authority to administer the National Pollution Discharge Elimination System (NPDES) permits once the U.S. EPA delegates this responsibility to DEP. The Division has the authority to regulate the building or alteration of structures within stream areas under the Stream Encroachment Act, and to regulate development and land use in designated floodways under the Flood Hazard Areas Act of the state. The Division is also responsible for supervising the development of public water supply schemes. The Division issues the water quality certification for any project that may affect the state water quality.

Division of Environmental Quality

This Division is responsible for air quality planning and monitoring, and is the designated agency to administer the Federal Clean Air Act in the state. Among others, it is also responsible for the pesticide control program.

Division of Parks and Forestry

This Division reviews CAFRA permit applications in addition to coordinating with OCZM on park and recreation policies.

Division of Fish, Game and Shellfisheries

This Division is responsible for managing the fish and wildlife resources of the state. It administers the Federal Endangered Species Act of 1973 within the state.

Solid Waste Administration (SWA)

The Resource, Conservation and Recovery Act of 1976 placed primary responsibility for planning and regulation of solid waste management on state governments, and in New Jersey, it is administered by the SWA. The agency is empowered to promulgate and enforce regulations pertaining to the design, operation, and maintenance of all solid waste collection and disposal systems, and operation of waste lagoons. The SWA develops a statewide waste management plan and provides guidance for district plans under the State Solid Waste Management Act, PL 1975, Chapter 326. Any waste material, including dredge spoil, when contaminated, is considered as solid waste under this Act.

New Jersey--Office of Coastal Zone Management (OCZM)

The state OCZM is under the Division of Marine Services of the Department of Environmental Protection. The OCZM is the lead agency for coastal planning in the state. The policy of this

office is established by the Federal Coastal Zone Management Act of 1972 (PL 92-583) which establishes a national policy to preserve, protect, develop, and where possible, restore or enhance the resources of the coastal zone of the United States. It provides for monetary assistance to the states to facilitate utilization of coastal zone resources, coupled with adequate protection of the coastal zone environment, through development and implementation of state-wide comprehensive Coastal Zone Management (CZM) programs. Section 307 mandates Federal interagency coordination and cooperation in concert with state coastal zone management programs. Federal agencies must cooperate and actively participate with state and local governments and regional agencies towards achieving integrated policy and action proposals at all levels of government. Future Corps actions should be consistent, to the maximum extent feasible, with the state's approved CZM programs and plans. The Corps' traditional area of regulatory jurisdiction overlaps and interacts with state CZM agency policies. Close and continuing coordination is required between the Corps and state CZM agencies to insure that issuance of permits is in conformity with the state CZM plans. The OCZM also administers the CAFRA permit program.

New Jersey--Department of Agriculture

The Department was established in 1916, and is directed by the state Board of Agriculture. The Board is empowered to establish

rules and regulations concerning livestock and plant disease control, and the marketing of agricultural products. The activities of the Department can, and frequently do, affect environmental quality, and thus become part of the agencies involved in environmental quality assessment.

The Department shares with the N.J. DEP the regulatory responsibility of the Soil Erosion and Sedimentation Control Act which is administered by the state Soil Conservation Committee. The law controls erosion and sediment during the construction phase of development.

New Jersey--Department of Community Affairs (DCA)

This Department oversees the municipal planning function in New Jersey, providing valuable technical and financial assistance to local governments. Created in 1966, the Department provides a state-led attack on the various problems stemming directly from the state's rapid urbanization. Among the various divisions and bureaus under this department, the Division of State and Regional Planning, and the Division of Housing and Urban Renewal are the ones which are directly involved in the local planning and renewal efforts. Although not required by law, DCA participates in the review of CAFRA permit applications. It is responsible for the development of a State Development Guide Plan under Section 701 of the Federal Housing and Community Development Act. New Jersey DCA is the designated state clearinghouse.

New Jersey--Department of Transportation (DOT)

The DOT was created in December 1966. It is authorized to design, construct, and maintain state highways and bridges. It is empowered to enter onto adjacent lands to preserve stream banks or construct other facilities as may be necessary. The DOT administers permit programs for transportation facilities, as well as having grants for transportation projects and eminent domain powers. The DOT has a working relationship with the N.J. DEP to meet the transportation needs of coastal areas. For any road, highway or airport construction, DOT is required to obtain a permit if the construction is within the coastal area and administered under the CAFRA permit program. Projects crossing wetlands or riparian lands require the appropriate additional permits.

New Jersey--State Budget Office

The departments of state government formulate their budget plans working with the Budget Office and determining their projected financial needs. The Budget Director conducts public hearings on each department's budget for the following year, before it is recommended to the governor for approval.

DELAWARE

Delaware -- Department of Natural Resources and Environmental Control (DNREC)

Title 29 of the Delaware Code, Chapter 80, established the Department of Natural Resources and Environmental Control (DNREC).

DNREC is charged with the primary responsibility of preservation and protection of the environment and natural resources. The Department is authorized, under Title 7, Chapter 68 of the Code, to enhance, preserve, and protect public and private beaches in Delaware. This Beach Preservation Act (6 May 1974) requires DNREC to prevent and repair damage from erosion of public beaches and in emergency situations, the private beaches. All structures constructed to prevent erosion such as groins, jetties, banks, dikes, dunes, bulkheads, sea walls, and breakwaters may need a permit from DNREC.

Title 7, Chapter 61, authorizes DNREC to regulate the use of public submerged lands throughout the state by the Subaqueous Lands Act (14 July 1969). Among the various activities regulated by this Act are: dredging or filling; excavation of any channel, lagoon, basin or ditch on public or private lands which will make connection with public subaqueous lands and wetlands. Any activity requires a permit from DNREC.

The Department is authorized to regulate specific activities related to air and water pollution within the state through the Environmental Protection Act, Title 7, Chapter 60. Specific regulations include: the regulations governing the control of water pollution; water quality standards for streams; solid waste disposal regulations; regulations governing the control of air

pollution and implementation plans; and regulations governing the installation and operation of septic tank sewage systems.

Title 7, Chapter 66, of the Delaware Code authorizes DNREC to regulate wetlands in Delaware through the Wetlands Act. Any activity such as dredging, draining, filling, or construction of any kind in the wetlands requires a permit from the Department.

Division of Environmental Control

Title 7, Chapter 60, of the Delaware Code, provides for the Division of Environmental Control. The Division is responsible for the regulation of public, private, and industrial developments with regard to their impact on air, water, and land resources of the state, and to their suitability for human habitation. Chapter 60 requires that a permit be obtained from DNREC for the discharge of pollutants into the air or water in the state, for the withdrawal of ground- or surfacewater, for the processing and disposal of solid waste, or for the construction of any water facility or highway. Furthermore, it has the authority to seal noncomplying equipment and stop hazardous operations. A license is required for the transportation of any liquid or solid waste.

Division of Soil and Water Conservation

The Division of Soil and Water Conservation administers the state programs for beach erosion control, tax ditching (for drainage), and dredging. The state program operates through countywide Conservation Districts.

Division of Parks and Recreation

This Division is charged with providing land for natural resource preservation and for active recreational use by the general public. It is also responsible for carrying out statewide recreational planning as authorized by the Heritage Conservation and Recreation Service of the U.S. Department of the Interior.

Division of Fish and Wildlife

This Division is responsible for acquiring, protecting and improving suitable lands and water for game propagation and protection. Most of these lands provide hunting and fishing areas for the general public.

Delaware--Department of Health and Social Services, Division of Public Health

The principal objectives of this agency are the prevention of disease or injury, the protection of all public water supplies, and the general protection of public health. The Division is responsible for monitoring potable water supplies and for determining the suitability of waters for recreation, shellfishing, and fin fishing. The regulations and health standards established by the agency supersede those set forth by local jurisdictions. In addition, the agency is empowered to preserve the public health within all incorporated towns, and within a one-mile radius of any town's water supply. Local health boards at the county level administer the Division's rules and regulations.

Delaware--Department of Transportation, Division of Highways

This agency is responsible for providing, maintaining, and overseeing safe and adequate modes of transportation throughout the state. The Division of Highways is charged solely with the planning, design, and construction of highways. In fulfilling this function, the Division participates in many land development decisions that could affect dredge spoil disposal site selections within the state.

Delaware--Department of Community Affairs and Economic Development

The Department of Community Affairs and Economic Development was established through Title 29, Chapter 86, of the Delaware Code. This department is given the responsibility for attracting industry to the state, but with a view to preserving existing agricultural, commercial, and recreational opportunities, as well as conserving the state's natural resources and wildlife.

Delaware--Solid Waste Authority

Title 7, Chapter 64 of the Delaware Code establishes the statewide authority for solid waste management. The functional role of this Authority includes the operation of solid waste disposal, resource recovery, general support facilities, the provision of solid waste management services to contracted public or private entities, coordination of recycling efforts, assistance in the

development of waste recovery industries in the state, and licensing of solid waste transporters. The Solid Waste Authority is also empowered to make planning studies, to design facilities, and to inspect lands. The Authority must also develop and implement a statewide waste management plan.

Delaware--Office of Management, Budget, and Planning (OMB&P)

The Office of Management, Budget, and Planning, formerly known as the State Planning Office, is primarily an advisory, consulting, and coordinating body responsible for setting growth and development policies in the state through the integration of Federal, regional, and local programs. The OMB&P is, therefore, quite influential in establishing the overall growth pattern in Delaware. It is the designated state clearinghouse in Delaware. This Office also administers Delaware's Coastal Zone Act (Title 7, Chapter 70 of the Delaware Code) through the Office of Coastal Zone Management (OCZM).

The Office of Coastal Zone Management is concerned with the nonpoint source pollution problem in the state, especially in consideration of the protection and preservation of the coastal zone. Water pollution attributed to agricultural practices, septic-tank leachate, construction runoff, and urban storm runoff are specific concerns. The Federal Coastal Zone Management Act of 1972 (PL 92-583) authorizes the development and implementation

of the statewide comprehensive Coastal Zone Management Program. The Act provides that certain Federal projects, permits and licenses, Outer Continental Shelf (OCS) exploration plans, and grants-in-aid must, to the maximum extent practicable, be consistent with the state's approved Coastal Management Program. The consistency review requirements contained in Delaware's Coastal Management Program will be an important benefit of an approved program. Federal agencies must notify the Office of Management, Budget and Planning (OMB&P) at the earliest practicable time of existing or proposed Federally-conducted or supported activities directly affecting the coastal management area. The Federal agencies must ensure that their activities and development projects are consistent to the maximum extent practicable with the enforceable policies of the management program.

PENNSYLVANIA

Pennsylvania--Department of Environmental Resources (DER)

The Department of Environmental Resources was created by Act 275 of 1970. The Department provides for the development of a balanced environment, encompassing the social, cultural, and economic needs of the people through the development of environmental resources. DER is responsible for the state's land and water management programs, all aspects of environmental control, including the regulation of mining operations. More specifically, the Department is active in the areas of permits, monitoring and surveillance, enforcement, certification and training, planning, financial

assistance, and legal authority. Some of the programs are based on provisions of Pennsylvania's Clean Streams Law and the Federal Water Pollution Control Act Amendments of 1972.

DER also controls the construction and maintenance of dams, bridges, culverts, dikes and other obstructions through the Water Obstructions Act (PL 555) as amended and subsequent regulations, 25, of the Pennsylvania Code. The Water Obstructions Act pertains to fill operations, and also to dredging, because of its application to "all changes in the course, current or cross-section of any stream or body of water, whether such change be temporary or permanent." However, it should be noted that the tidal waters of the Delaware River and its navigable tributaries are exempt from the Water Obstructions Act.

Under the powers of the Water Obstructions Act, the Commonwealth may regulate filling in wetlands. The Commonwealth is empowered to acquire wetlands under the general language of the Open Space Lands Act, 32 PS; it may maintain a development right or easement for the property. The bureaus within DER, discussed in the following paragraphs, may directly or indirectly affect dredge spoil disposal activities.

The Bureau of Water Quality Management plans, directs, coordinates, and enforces the state's Water Quality Management Programs, through enforcement of the Clean Streams Act, the Federal Water Pollution

Act (PL 92-500), and other Federal and state legislation. This agency is responsible for public water supply and sewerage, water pollution control activities, establishment of water quality standards, industrial wastes, erosion regulation, and dams and encroachments.

The Bureau of Community Environmental Control administers the provisions of the Pennsylvania Sewage Facilities Act, including review and approval of official municipal sewage plans, and administration of grants for sewage facilities planning. This Bureau also conducts surveys to determine the extent of individual water supply problems, and promotes public water supply in areas having groundwater contamination problems. It also directs, plans, and coordinates planning and enforcement programs for state and local recreational facilities.

The Bureau of Land Protection, which encompasses the Division of Solid Waste Management, regulates land-based waste disposal activities. The Bureau also administers grant and loan programs for solid waste management planning and resource recovery projects. Act 241, the Solid Waste Management Act of 1968 is intended to regulate the storage, collection, transportation, processing, and disposal of solid waste in a way which will prevent the pollution of water and land resources. The Act mandates that DER establish standards for planning and the criteria for determining

whether a particular disposal site or processing facility could be issued a permit. DER continues to monitor and observe facilities to insure against future pollution dangers.

The Bureau of Soil and Water Conservation implements responsibilities mandated in the Soil Conservation Law. The Bureau also implements Environmental Quality Board rules and regulations on erosion and sediment control. It provides administrative, advisory, and financial assistance to the 66 Conservation Districts in the state.

The Bureau of Forestry, prepares and maintains a Forest Resource Management Plan. The Bureau protects water resources, facilitates flood prevention and soil erosion control, and assists in providing recreational opportunities in the state.

The Pennsylvania Coastal Zone Management Program, which is now in its draft form, is handled by the Bureau of Resources Programming of the Office of Resources Management under the Department of Environmental Resources. DER hired DVRPC as a consultant to assist them in the preparation of this draft, which is now (April 1979) in circulation among the review agencies and coastal area municipalities for their comments. The draft Coastal Zone Policy Framework, Part II summarizes problems, policies, and legal authorities for dredging spoil disposal activities, and Part IV refers

to the authorities concerning wetlands. According to this Framework, sites identified as "areas of significant natural values" (GAPC) and wetlands shall not be filled with dredged spoil. Permits will be granted to allow dredging and spoil disposal in conjunction with port-related and harbor facilities. Dredging, filling, placing structures upon, and removing materials from the bed of navigable waters shall not be allowed if it adversely affects the public interest, or is specifically harmful to fish or game habitat, materially obstructs navigation, or reduces effective flood flow capacity.

Projects involving the placement of dredged or fill materials in wetlands will be denied if the project is not primarily dependent on being located in, or in close proximity to the aquatic environment, or if alternative sites are available.

Pennsylvania Fish Commission

The Pennsylvania Fish Commission was created by the Act of 25 April 1949. The Commission shall make, administer, and enforce rules and regulations relating to boating and the protection, propagation, and distribution of fish, and for the angling, catching or removal of fish in or from any waters, wholly within, or in waters lying between the Commonwealth and any other state. It also controls and manages all hatching stations and fish culture establishments, including the distribution or planting of fish in

designated waters. The Commission is also authorized to enter into cooperative agreements with agencies of the U.S. government, interstate compact agencies, and other agencies, including authorities and soil conservation agencies for impounding, managing, using, maintaining and operating waters for public fishing.

Pennsylvania--Department of Transportation (PennDOT)

PennDOT was created on 6 May 1970 by Act No. 120. The Department's primary duties include the following: develop and maintain a comprehensive and coordinated transportation planning process (including rail and bus activities), and construction, repair, and maintenance of state-designated highways and transportation facilities and rights of way.

The Department is required to consider erosion, sedimentation, water pollution, recreation, and public health factors and effects of any transportation route or program. The possibility of using the dredged spoil in road construction would bring the Department in contact with the disposal study.

Pennsylvania--Department of Commerce,
Navigation Commission

The Navigation Commission for the Delaware River and its navigable tributaries is a departmental commission of the Department of Commerce. The commission is authorized to prescribe rules and

regulations for the government with respect to the activities in, and uses of the Delaware River and the tidal portions of its navigable tributaries, namely, portions of the Schuylkill River, and Chester, Crum, Darby, Neshaminy, Pennypack, and Ridley Creeks.

Section 203.11 of the Commission's regulations prohibit anyone constructing on, into, or over the River without first obtaining a construction permit from the Commission. If dredging or dumping is proposed, the construction plan should include the exact location of the work, the depth to which the dredging is to be carried, the appropriate amount of material to be removed, and explanation as to how and where the dredged material is to be deposited. Section 4 of the Act of 8 June 1907 (PL 496, No. 322) authorizes the Commissioners to make rules for regulating, stationing, and anchoring ships, vessels, and boats in the River and its navigable tributaries.

Pennsylvania--Department of Community Affairs (DCA)

The Department of Community Affairs was created by the General Assembly in 1966. This Department, through its various bureaus, is responsible for urban renewal, and housing and community development. The agency provides technical assistance for recreation, conservation, and various planning programs. Through the Bureau of Community Planning, the Department gives detailed technical assistance on planning, zoning, subdivision regulations, and

flood land controls. It administers the Federal Flood Insurance program in Pennsylvania. The Department also directs programs for social and economic development within the state.

Pennsylvania--Office of the Budget

This Office is authorized by the Administrative Code of 1929. It is the designated state clearinghouse in Pennsylvania, and is under the direct supervision of the Budget Secretary, who reports to the Governor. The Office of the Budget has the responsibility for preparing the Governor's budgets, coordinating capital improvements, implementing the planning/programming/budgeting system, and maintaining liaison between the Governor's Office and the several state authorities. It maintains a continuing evaluation of the progress and effectiveness of state programs in meeting program objectives.

LOCAL AGENCIES

There are 13 counties which lie partially or wholly within the study area. They are:

1. New Jersey
    a. Burlington
    b. Camden
    c. Cape May
    d. Cumberland
    e. Gloucester
    f. Mercer
    g. Salem
2. Delaware
    a. Kent
    b. New Castle
    c. Sussex
3. Pennsylvania
    a. Bucks
    b. Delaware
    c. Philadelphia

There are a number of agencies in each of these counties which will directly or indirectly be affected or will affect the dredge spoil disposal activities through their authority or reviewing process.

The major agencies in the counties of concern, which may have a role in the dredging spoil disposal activities are discussed in the following paragraphs.

NEW JERSEY

New Jersey--Burlington County

There are a number of agencies in the county which may affect or be affected by the selection of a dredge spoil disposal site. One of these departments, the County Planning Board, is required to make and adopt a master plan for the physical development of the county. The board is the reviewing agency of all subdivision plans, and approves all zoning changes.

The County Health Department monitors solid waste disposal practices in the county, as the agent of local Boards of Health. The Health Department routinely inspects landfills in the county and responds to any complaints concerning their operation. The Department's Office of Waste Management Programs is the lead agency in developing a District (i.e., county) Solid Waste Management Plan, and administers and coordinates all county refuse management studies, such as the recent Energy Market Survey and current Source Separation Feasibility Project.

The Solid Waste Advisory Committee, empowered by the Solid Waste Authorities Law (N.J. SA 40:66A-32, et sq.) is charged with the acquisition, financing, and operation of systems for the collection and disposal of garbage and solid waste.

The <u>County Conservation District</u>, which functions under the New Jersey Revised Statutes Title 4, Chapter 24, investigates erosion and natural resource problems, and carries out control measures to preserve these resources. In regard to dredge spoil studies, the District analyzes drainage, erosion, and sedimentation problems and solutions.

Finally, the <u>County Highway Department</u> maintains and improves the county road system, while the <u>County Engineering Department</u> designs and constructs the county's road and bridge system.

<u>New Jersey--Camden County</u>

The agencies in Camden County that might affect or be affected by dredge disposal activities include the County Planning Board, the County Health Department, the Solid Waste Advisory Council, the County Soil Conservation District, and the Engineering Department.

The <u>Camden County Planning Board</u> is required to prepare and adopt a comprehensive plan for development, and advises the freeholders on the formulation of development programs and budgets for capital expenditures. It also reviews all subdivisions of land, and withholds approval of subdivisions that adversely affect county road or drainage facilities.

The County Health Department is concerned not only with public health and sanitation laws, but with the environmental health field also. Local Boards of Health adopt rules concerning garbage, sewers and dumps, and water supply.

The Solid Waste Advisory Council, as empowered by the Solid Waste Authorities Law, is responsible for the operational and financial aspects of collection and disposal of garbage and solid waste.

The Soil Conservation District is generally responsible for the conservation of soil resources, the control and prevention of erosion, prevention of damage by flooding, and the conservation of water for agricultural purposes.

The Engineering Department and Highway Department, together, function to design, construct, and maintain the county's roads and bridges.

New Jersey--Cape May County

One of the agencies in Cape May County that may be involved with dredge spoil disposal activities is the County Planning Board (established under enabling state legislation adopted in 1935) which is required to develop and adopt a master plan for the physical development of the county. The County Planning Board

is the designated areawide clearinghouse, and as such is the responsible review agency for the county. The Board reviews any EIS, site plan, subdivision change, or zoning change in regard to the selection of a dredge disposal site. It also advises the freeholders on the development of such plans and budgets for capital expenditures.

The Solid Waste Management Council is one of the newest agencies in the Cape May county government. Its responsibilities include the collection and disposal of garbage, solid waste, and other refuse materials.

The Cape May County Conservation District monitors erosion and sedimentation problems within the county. The District advises landowners in practices of soil and water conservation, especially with regard to agricultural needs. The District is empowered to carry out control measures where needed.

The County Health Department is required to enforce public health laws and the state Sanitary Code. Working with the local Boards of Health, the Department monitors water supply, sanitation in public places, garbage, sewers, and dumps.

The County Engineering Department would be involved with a dredge spoil site selection only if it involves county roads and/or bridges, as the Department is responsible for their design and construction.

New Jersey--Cumberland County

The Cumberland County agencies discussed in the following paragraphs may be directly or indirectly involved with dredge spoil disposal activities.

The County Planning Board is the designated areawide clearinghouse for the county and as the responsible reviewing agency, it develops a master plan for the physical development of the county. The Board reviews all subdivision and zoning regulations and actions.

The County Soil Conservation District is a review body, primarily involved with erosion and sedimentation control. The District is also concerned with flooding and drainage problems.

The Department of Health is responsible for providing a safe public water supply, and enforcing the state Sanitary Code. In order to carry out these responsibilities, the Department has the power to conduct inspections and investigations, and approve permits of on-site sewer systems.

The Engineering Department has limited involvement in dredging disposal site selection, as its primary role is design and construction of county roads and bridges.

The county is now in the process of setting up a Solid Waste Advisory Council, as authorized by the Solid Waste Management Law of the early 1970's. The Council will be primarily responsible for the collection and disposal of garbage and solid waste.

New Jersey--Gloucester County

One of the agencies in Gloucester County involved in dredging spoil disposal site selection is the County Planning Board which reviews any disposal site selected. The Board also reviews zoning changes required to be adopted in order to accommodate such a disposal site. The board develops the land use and development plan, and reviews all subdivision plans for the county.

The County Solid Waste Advisory Council authorizes the acquisition, financing, and operation of systems for the collection and disposal of garbage, solid waste, and refuse matter. The Council is currently working on a Solid Waste Management Plan.

The Gloucester County Conservation District provides guidance in the areas of erosion and sedimentation control. The District offers assistance to landowners, and is empowered to investigate resource problems and to carry out the appropriate control measures.

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The Conservation District also monitors damage from flooding and water resources used for agricultural purposes.

The County Health Department works very closely with the local Boards of Health. The Department's duties include the adoption of ordinances and rules in the areas of water supply, sanitation in eating places, garbage, sewers, and dumps. Local boards also have broad powers to conduct inspections and investigations.

The Engineering Department has limited involvement in a dredging spoil study, except in a situation where the selected site involves a county road or bridge.

New Jersey--Mercer County

The Mercer County government is organized under the provisions of the County Executive Plan of the Optional County Charter Law (N.J. SA 40:41A-1 et. seq.). The departments discussed in the following paragraphs may be indirectly involved with dredge spoil studies. The County Planning Division is responsible for coordinating land use, and economic and environmental planning activities in the county. The Improvement Authority presently has three major responsibilities: supervision of the public transportation service agency, the Mercer Metro Division; direction of the countywide Solid Waste Plan; and coordination with various state and local governments in helping to develop various improvement projects.

The Department of Public Works is responsible for the construction and maintenance of county roads, bridges, and culverts; the administration of shade tree programs; installation of traffic signals; and operation of the county airport.

The Mercer County Health Department monitors such areas as water supply, sewers, and dumps. The county works closely with local Boards of Health in adopting rules and ordinances in these areas. They enforce public health laws and the state Sanitary Code.

The County Soil Conservation District provides for conservation of soil resources, and control and prevention of erosion. It is also concerned with the prevention of damage by floodwaters.

New Jersey--Salem County

The public institutions under the Salem County government which will directly or indirectly be affected by the dredging spoil disposal activities are discussed in the following paragraphs.

The County Planning Board is the reviewing authority on any subdivision development, especially that which affects county drainage facilities and county roads; reviews site plans which impact directly on county roads; prepares county land use plans; and, reviews municipal plans.

The Solid Waste Advisory Council is presently in charge of preparing the Solid Waste Management Plan for the county, working directly under the Board of Freeholders. The Council may become an authority or will work under the County Improvement Authority once the plan is adopted.

The Department of Health conducts inspections on buildings, and issues permits for buildings at sites where septic capability is an issue. The Department reviews any study proposals which may affect the county.

The Soil Conservation District is a review body providing guidance to control erosion and sedimentation. On a voluntary basis, it prepares soil conservation plans for farmers, and reviews any development plan which disturbs more than 5,000 square feet of land area. The District develops stream sedimentation control proposals.

The County Engineer's Office is involved with county roads and structures, and drainage facilities.

The County Mosquito Commission is involved in drainage effectiveness, and construction of dikes and other measures to eliminate stagnant water problems.

The County Improvement Authority is interested in reclaiming some of the existing dredging spoil disposal sites for industrial development activities.

DELAWARE

Delaware--Kent County

There are only a few institutions in the county which may be affected by or affect dredging spoil disposal site selection. Two of these are the Kent County Regional Planning Commission and the County Engineer's Office. They make recommendations to the Kent County Levy Court, which is the county governing body composed of elected officials.

The Regional Planning Commission reviews any EIS prepared in relation to a proposed dredging spoil disposal site, as well as any zoning ordinance change required. The County Engineer's Office would technically cover any public health responsibilities and any responsibilities with respect to building permits or county buildings. The County Engineer is also responsible for the drainage code and its administration.

There is no county landfill office in Kent County, unlike the other two counties of the state, but such matters would be monitored by the County Engineer's Office. Kent County has two County Agricultural Agents working for the University of Delaware

Cooperative Extension Service. They provide technical and educational expertise in various areas of land management. The Kent County Conservation District works very closely with the Soil Conservation Service, and is primarily charged with the protection of soil and water resources, with special emphasis on soil erosion.

Delaware--New Castle County

There is very little direct involvement for the New Castle County agencies regarding dredge spoil disposal plans. Proposed disposal sites are considered as nonpoint pollution sources from a water quality standpoint. The authority for developing processes to control such practices is contained in Section 208 (2)(K) of PL 92-500, of the Federal Water Pollution Control Act. The Water Resources Agency for New Castle County reviews all plans concerning dredge spoil disposal studies, as they pertain to water quality.

Other agencies that may be indirectly affected by the dredge spoil plan are: 1) the County Council, which is the primary legislative and administrative agency in the county; 2) the Department of Planning, which prepares land use, subdivision, and zoning plans; 3) the County Landfill Office, responsible for the operation and maintenance of the county's landfill; 4) the New Castle County Conservation District, which serves to control and prevent soil erosion and to conserve, protect, and manage soil and water resources; and 5) the Cooperative Extension Service, which

provides technical and educational information to the public, particularly in regard to agricultural and land management practices.

Delaware--Sussex County

Sussex County is unique in the fact that one department, the County Administrator's Office, directly reviews all dredging spoil disposal matters. The Public Works Engineer in this agency acts as the liaison between the county and state, reviews all plans concerning site selection for dredge spoils disposal, and sometimes prepares EIS's in conjunction with the selection of a site.

The Sussex County Council is the primary legislative and administrative agency in the county. The agency has the authority to review (approve/disapprove) plans regarding zoning, subdivision regulations, and sewerage and water facility plans; enact legislation; and appropriate funds for all programs.

The County Planning and Zoning Commission conducts land use planning, and subdivision and development proposal review. It also enforces the county zoning ordinance, which was adopted in 1972, and provides the general framework for growth and development within the county.

The County Landfill Office has the primary responsibility for planning and maintaining solid waste disposal facilities.

The Sussex Conservation District has the responsibility to control and prevent soil erosion, and to conserve and protect soil and water resources. Along with this, the District develops conservation plans and programs directed toward local needs.

The Cooperative Extension Service is an agency which operates from the Land Grant College System through the University of Delaware. The Extension Service provides technical consultation and educational information to the public, especially in regard to land management practices.

PENNSYLVANIA

Pennsylvania--Bucks County

There are a number of institutions in the county which may be affected or will affect the selection of any site in Bucks County for dredging spoil disposal. The county Planning Commission and the county Department of Health, both of which work for the County Commissioners, are the primary agencies in Bucks County which may be involved in such a site selection. The Planning Commission will review any EIS prepared in conjunction with the selection of a site within the county. It will also review zoning changes required to be adopted in order to accommodate such a disposal

site within an area zoned for other uses. The County Planning Commission has the subdivision control responsibility for seven out of the 54 municipalities in the county, through the powers delegated to the county by Act 247, the Pennsylvania Municipalities Planning Code.

The Department of Health is involved with approving permits for on-site sewer systems, water supply projects, etc. so as to be able to monitor and abate public health hazards in the county. The Department of Health inspects development works under the state erosion and sedimentation control authority, and the Bureau of Environmental Health handles the enforcement aspect of the program for the State Department of Environmental Resources, in conjunction with the County Conservation District.

The Solid Waste Advisory Board of the county is presently inactive. The Solid Waste Management Plan of the county adopted in 1971 was prepared by a division under the County Planning Commission.

Pennsylvania--Delaware County

The agencies of the county involved in dredging spoil disposal site selection include the County Planning Department, and the Department of Solid Wastes. However, the final authority for issuance of permits rests with the state Department of Environmental Resources. The County Planning Department reviews any

site selected, and, depending on its effect on the county environment and the facilities, the plan will be referred to the Department of Solid Wastes or the County Conservation District for their comments. The Planning Department has authority over subdivision regulations for 27 municipalities in the county, while all municipalities have their own zoning regulations and authority, as per the Pennsylvania Municipalities Planning Code, Act 247.

The county has jurisdiction over the solid waste management activities through Act 241, the Pennsylvania Solid Waste Management Act. The Solid Waste Management Plan for the county was developed by the Planning Department and is being implemented by the Department of Solid Wastes. The public health aspects of the county are directly handled by the State Department of Health.

The County Conservation District handles the soil erosion and sedimentation control aspects of the county. The District is also involved in the drainage system. The County Engineering Department has limited involvement in a dredging spoil disposal site selection process, except in case the site selected involves any of the county bridges or buildings.

The ultimate authority in the county is with the municipalities which have powers to handle any site development or zoning changes necessitated by the selection of any site for dredging spoil disposal.

Pennsylvania--City of Philadelphia

The agencies within the City of Philadelphia (which is also a county) which will directly or indirectly be affected by the dredging spoil disposal activities are discussed in the following paragraphs.

The City Planning Commission prepares and reviews comprehensive plans and long-range development plans. The Commission will review any EIS prepared in relation to a dredge disposal site within the city. It also reviews zoning plans and reports directly to the City Council.

The Department of Public Health is charged with the prevention of disease and mental, physical, and social well-being of the residents of the city. The Department also deals with communicable disease and the quality of water (specifically, fluoridation and bacteriological levels). Well specifications must also be approved by this Department.

The Water Department of the City of Philadelphia is responsible for more specific water quality measures through the Department's four divisions: 1) the Water Pollution Control Division, 2) the Water Treatment Division, 3) the Construction Division, and 4) the Research and Development Division. The Departments include conveyance and treatment of wastewater and sludge, providing an acceptable water supply for the city, and the design and con-

struction of new facilities for wastewater treatment and management.

The Department most directly involved with dredging activities in the city, is the Department of Commerce. It is in this department that applications and site plans for any dredging activity in Philadelphia must be filed, and upon acceptance, permits issued. The Department of Commerce controls water obstructions related to wharves, piers, bulkheads, docks, ships, and basins within the city limits, but it has no power over changes in the current, course or cross-section of the stream.

MUNICIPALITIES

The changes in development patterns or zoning ordinances due to a disposal plan could have a more direct impact on the local municipalities than the counties they are part of. However, since this review does not involve the impacts on site specific locations, and since the number of municipalities within the study area counties is in the hundreds, the agencies of these municipalities and their responsibilities are not discussed here. In general, most of these municipalities have: 1) a planning commission (or department) which is in charge of preparing planning studies and monitoring the growth of the municipality with respect to its comprehensive plan, if any; 2) a zoning board (or department) which is empowered to review any project that involves the municipality land area, for their compliance with the current zoning designation;

and, 3) departments of recreation, health, safety and finance (or budget).

The municipalities in each of the 13 counties of the study area are listed on the following pages.

NEW JERSEY

Burlington County

Bass River Twp.
Beverly City
Bordentown City
Bordentown Twp.
Burlington City
Burlington Twp.
Chesterfield Twp.
Cinnaminson Twp.
Delanco Twp.
Delran Twp.
Eastampton Twp.
Edgewater Park Twp.
Evesham Twp.
Fieldsboro Boro
Florence Twp.
Hainesport Twp.
Lumberton Twp.
Mansfield Twp.
Maple Shade Twp.
Medford Twp.

Burlington County (continued)

Medford Lakes Boro
Moorestown Twp.
Mt. Holly Twp.
Mt. Laurel Twp.
New Hanover Twp.
North Hanover Twp.
Palmyra Boro
Pemberton Boro
Pemberton Twp.
Riverside Twp.
Riverton Boro
Shamong Twp.
Southampton Twp.
Springfield Twp.
Tabernacle Twp.
Washington Twp.
Westampton Twp.
Willingboro Twp.
Woodland Twp.
Wrightstown Boro

Camden County

Audubon Boro
Audubon Park Boro
Barrington Boro
Bellmawr Boro
Berlin Boro
Berlin Twp.
Brooklawn Boro
Camden City
Cherry Hill Twp.
Chesilhurst Boro
Clementon Boro
Collingswood Boro
Gibbsboro Boro
Gloucester City
Gloucester Twp.
Haddon Twp.
Haddonfield Boro
Haddon Heights Boro
Hi-Nella Boro
Laurel Springs Boro

NEW JERSEY

Camden County (continued)

Lawnside Boro

Lindenwold Boro

Magnolia Boro

Merchantville Boro

Mt. Ephraim Boro

Oaklyn Boro

Pennsauken Twp.

Pine Hill Boro

Pine Valley Boro

Runnemede Boro

Somerdale Boro

Stratford Boro

Tavistock Boro

Voorhees Twp.

Waterford Twp.

Winslow Twp.

Wood-Lynne Boro

Cape May County

Avalon Boro

Cape May City

Cape May Point Boro

Dennis Twp.

Lower Twp.

Middle Twp.

North Wildwood City

Ocean City

Sea Isle City

Stone Harbor City

Upper Twp.

West Cape May Boro

West Wildwood Boro

Wildwood City

Wildwood Crest Boro

Woodbine Boro

Cumberland County

Bridgeton City

Commercial Twp.

Deerfield Twp.

Downe Twp.

Fairfield Twp.

Greenwich Twp.

Hopewell Twp.

Lawrence Twp.

Maurice River Twp.

Millville City

Shiloh Boro

Stow Creek Twp.

Upper Deerfield Twp.

Vineland City

NEW JERSEY

Gloucester County	Gloucester County (continued)	Salem County
Clayton Boro	Westville Boro	Alloway Twp.
Deptford Twp.	Woodbury City	Carneys Point Twp.[1]
East Greenwich Twp.	Woodbury Heights Boro	Elmer Boro
Elk Twp.	Woolwich Twp.	Elsinboro Twp.
Franklin Twp.	Mercer County	Lower Alloways Creek Twp.
Glassboro Boro	East Windsor Twp.	Mannington Twp.
Greenwich Twp.	Ewing Twp.	Oldmans Twp.
Harrison Twp.	Hamilton Twp.	Penns Grove Twp.
Logan Twp.	Hightstown Boro	Pennsville Twp.
Mantua Twp.	Hopewell Boro	Pilesgrove Twp.
Monroe Twp.	Hopewell Twp.	Pittsgrove Twp.
National Park Boro	Lawrence Twp.	Quinton Twp.
Newfield Boro	Pennington Boro	Salem City
Paulsboro Boro	Princeton Boro	Upper Pittsgrove Twp.
Pitman Boro	Princeton Twp.	Woodstown Boro
South Harrison Twp.	Trenton City	
Swedesboro Boro	Washington Twp.	
Washington Twp.	West Windsor Twp.	
Wenonah Boro		
West Deptford Twp.		

[1] Originally called Upper Penns Neck Township until 10 November 1975.

DELAWARE

Kent County

Bowers
Camden
Cheswold
Clayton
Dover
Farmington
Felton
Frederica
Harrington
Hartly
Houston
Kenton
Leipsic
Little Creek
Magnolia
Milford (Part)
Smyrna (Part)
Viola
Woodside
Wyoming

New Castle County

Arden
Ardentown
Bellefonte
Delaware City
Elsmere
Middletown
Newark
New Castle
Newport
Odessa
Smyrna (Part)
Townsend
Wilmington

Sussex County

Bethany Beach
Bethel
Blades
Bridgeville
Dagsboro
Delmar

Sussex County (continued)

Ellendale
Fenwick Island
Frankford
Georgetown
Greenwood
Henlopen Acres
Laurel
Lewes
Milford (Part)
Millsboro
Millville
Milton
Ocean View
Rehoboth Beach
Seaford
Selbyville
Slaughter Beach
South Bethany

PENNSYLVANIA

Bucks County	Bucks County (continued)	Bucks County (continued)
Bedminster Twp.	Lower Southampton Twp.	Solebury Twp.
Bensalem Twp.	Middletown Twp.	Springfield Twp.
Bridgeton Twp.	Milford Twp.	Telford Boro (Part)
Bristol Boro	Morrisville Boro	Tinicum Twp.
Bristol Twp.	New Britain Boro	Trumbauersville Boro
Buckingham Twp.	New Britain Twp.	Tullytown Boro
Chalfont Boro	New Hope Boro	Upper Makefield Twp.
Doylestown Boro	Newtown Boro	Upper Southampton Twp.
Doylestown Twp.	Newtown Twp.	Warminster Twp.
Dublin Boro	Nockamixon Twp.	Warrington Twp.
Durham Twp.	Northampton Twp.	Warwick Twp.
East Rockhill Twp.	Penndel Boro	West Rockhill Twp.
Falls Twp.	Perkasie Boro	Wrightstown Twp.
Haycock Twp.	Plumstead Twp.	Yardley Boro
Hilltown Twp.	Quakertown Boro	Delaware County
Hulmeville Boro	Richlandtown Boro	Aldan Boro
Ivyland Boro	Richland Twp.	Aston Twp.
Langhorne Boro	Riegelsville Boro	Bethel Twp.
Langhorne Manor Boro	Sellersville Boro	Birmingham Twp.
Lower Makefield Twp.	Silverdale Boro	Brookhaven Boro

PENNSYLVANIA

Delaware County (continued)	Delaware County (continued)	Philadelphia County
Chester City	Morton Boro	Philadelphia City
Chester Heights Boro	Nether Prov. Twp.	
Chester Twp.	Newtown Twp.	
Clifton Heights Boro	Norwood Boro	
Collingdale Boro	Parkside Boro	
Colwyn Boro	Prospect Park Boro	
Concord Twp.	Radnor Twp.	
Darby Boro	Ridley Park Boro	
Darby Twp.	Ridley Twp.	
East Lansdowne Boro	Rose Valley Boro	
Eddystone Boro	Rutledge Boro	
Edgemont Twp.	Sharon Hill Boro	
Folcroft Boro	Springfield Twp.	
Glenolden Boro	Swarthmore Boro	
Haverford Twp.	Thornbury Twp.	
Lansdowne Boro	Tinicum Twp.	
Lower Chichester Twp.	Trainer Boro	
Marcus Hook Boro	Upland Boro	
Marple Twp.	Upper Chichester Twp.	
Media Boro	Upper Darby Twp.	
Middletown Twp.	Upper Providence Twp.	
Millbourne Boro	Yeadon Boro	

APPENDIX G

BIBLIOGRAPHY

INTRODUCTION

A literature search for all data sources pertaining to environmental factors which are relevant to dredged material disposal was conducted in the study area. A bibliography developed as a result of this search was entered in a data base management system which includes key word indexing and cross referencing. All information was organized in a readily accessible manner to be easily retrieved and assist in identifying data gaps and conduct portions of the study.

There are over 350 sources that have been entered into the system to date. This system can be easily expanded as new data sources are found. The existing listing is on file in the District office.

Other sources include House and Senate Documents which were used to trace the histories of authorization of all Federal projects. They are cited in the project descriptions included in Appendix A. In addition, reports included in Natural Resources, Appendix C, and Cultural Resources, Appendix D, contain additional lists of referenced material.

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